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UNIVERSITY OF ALBERTA

MONEY, MODELING AND PAIN:
THE ROLE OF SELF-EFFICACY AND PAIN PERCEPTION

Ⓒ

BY

DIANE G. SYMBALUK

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
AND RESEARCH IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

DEPARTMENT OF SOCIOLOGY

EDMONTON, ALBERTA
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled MONEY, MODELING AND PAIN: THE ROLE OF SELF-EFFICACY AND PAIN PERCEPTION submitted by DIANE G. SYMBALUK in partial fulfillment of the requirements for the degree of MASTER OF ARTS.

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Dr. W. David Pierce

Dr. William Meloff

Judy Cameron
Dr. Judy Cameron

Date July 7 /93

Dedication

To my fiance and best friend, Bruce MacGregor, whose endless patience has without a doubt helped me maintain my sanity long enough to complete this project. I would like to thank Bruce for his continued love and support. He is to be commended for his patience during my many phases of elation and depression in what can only be described as the trials and tribulations of graduate study.

Abstract

The present experiment is designed to investigate how observing pain in others and monetary reward affect self-efficacy, pain perception and pain endurance. The present study is a 3x3 factorial experiment that crossed three levels of social modeling (pain-tolerant, pain-intolerant and no model) with three rates of monetary payment (zero, $1.00 and $2.00 per 20 seconds of exercise). Ninety male subjects are required to perform an isometric-sitting exercise that induces pain in the thigh muscles.

Results indicated that social modeling is a powerful predictor of pain endurance. Exposure to pain-tolerant models resulted in high endurance while exposure to intolerant models produced low tolerance for isometric-sitting. Also, social modeling affected pain threshold, change in pain ratings, change in heart rate and self-efficacy ratings. Path analysis indicated that perception of pain (rather than self-efficacy) mediates the effects of social modeling on endurance. Subjects exposed to tolerant models perceive pain quickly and thereby report low pain thresholds which translate to poor isometric performance. Exposure to tolerant models, on the other hand, produces less change in pain ratings and this measure of pain perception results in higher endurance. Rate of payment did not affect pain endurance in this study. The present experiment extends the generality of previous demonstrations of social modeling on pain behavior and is the first to show indirect effects of modeling on endurance through perceptions of pain.

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First of all I would like to commend my parents, Jackie and Larry Symbaluk, for tolerating me during my obnoxious teenage years. Through their guidance and influence as positive role models in my life, I came to value education and appreciate the role it would serve in furthering my career aspirations.

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Peer support is a necessary element for the successful completion of any educational program and I thank Barbara Allen for her friendship. Barbara and I shared many laughs, many long telephone conversations (as reflected in our long distance phone bills) and even a few neurotic moments when the stress challenged our abilities.

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INTRODUCTION

Pain is a fundamental fact of life. People are constantly faced with minor aches and pain due to overexertion, headaches and other conditions. Others suffer chronic forms of pain due to accident or disease. An important question is the role of the social environment in an individual's response to painful events.

Previous research has examined how an individual's perception of pain intensity and pain tolerance can be manipulated by various social influences. The purpose of this study is to examine how monetary reinforcement for enduring pain and observing others who are in pain affects a person's endurance of pain and perception of it. In addition, this study examines the influence of self-efficacy on these processes. Social modeling may affect perceptions of self-efficacy that in turn influence endurance of a painful exercise. Another possibility is that social modeling works through perceptions of pain to affect how long subjects last.

Cabanac (1986) examined the effects of monetary reinforcement on pain magnitude and endurance using an isometric-sitting exercise. Isometric-sitting is an exercise that involves taking an unsupported position against a wall with the thighs parallel to the floor and legs lowered to a 90 degree angle. A simpler way to describe this exercise is to imagine a person sitting against a wall without a seat. This is a difficult position to maintain because lactic acid quickly builds up in the thigh muscles producing a painful stimulus.

In Cabanac's repeated measures design, ten males with a mean age of 20.9 ± 0.8 (SE) years participated in six experimental sessions. Subjects received 10 French francs (FF) for their participation in each session. During the first experimental session, subjects were trained to give pain estimates every 20 seconds and were paid an additional 10 FF (resulting in a lump sum payment of 20 FF for this session). In the five subsequent sessions, subjects earned varying amounts (0.2, 0.5, 1.25, 3.125 and 7.81 FF) as a reward for each 20 seconds of isometric endurance. The ordering of the pay incentives was randomized for each subject.

Results indicated that initial increases in monetary reinforcement produced increases in endurance. However, at a certain point, endurance leveled off even though monetary reinforcement continued to increase. Thus, the utility of money decreased as a function of increasing pain. Estimates of pain increased linearly with time but did not change with rate of reinforcement.

Based on Cabanac's (1986) findings, the present study predicts that subjects who receive $1.00 for every 20 seconds that they endure a painful exercise will last longer than those who receive no monetary incentive. Subjects who receive $2.00 per 20 second interval will endure isometric-sitting for longer than subjects who are paid $1.00 or receive no payment. The amount of change in endurance, however, will be greater between the zero and $1.00 condition than between the $1.00 and $2.00 condition, reflecting a decreasing utility of money. Estimates of pain magnitude should increase linearly with time but remain independent of reward level.

Recent studies have demonstrated how various cognitive strategies enhance performance of a painful task. Taken together, these studies have shown that pain-coping skills, relaxation training, informative feedback, clarification information, outcome expectancy information, self-management training, attention-diversion skills, goal specification, imagery practice, and visualization procedures increased pain tolerance and enhanced performance on painful tasks (Avia & Kanfer, 1980; Baker & Kirsch, 1991; Berntzen, 1987; Dworkin, Chen, Schubert & Clark, 1984; Gauron & Bowers, 1986; Grimm & Kanfer, 1976; Keefe, Caldwell, Williams, Gil, Mitchell, Robertson, Martinez, Nunley, Beckham, Crisson & Helms, 1990; Thorn & Williams, 1989; Vallis & Bucher, 1986).

Social modeling is a particularly effective cognitive strategy used to increase tolerance for a painful task. Social modeling is based on observational learning theory. Individuals often acquire new skills and behaviors by observing the actions of others. In addition, viewing the behavior of others can enhance or inhibit an observer's own performance of that behavior (Bandura, 1986).

Many studies have shown that subjects exposed to tolerant models accept higher levels of shock and endure electrical shocks for longer than subjects who are exposed to an intolerant model (Bandura, Adams, Hardy & Howells, 1980; Craig, 1986; Craig & Neidermayer, 1974; Craig, Best & Ward, 1975; Patrick, Craig & Prkachin, 1986; Prkachin, Currie & Craig, 1983; Prkachin & Craig, 1985;).

Other studies have substantiated tolerant model influences on pain endurance using a cold-pressor test (Craig & Patrick, 1985; Thelen & Fry, 1981; Turkat & Guise, 1983a; Turkat, Guise, & Carter, 1983b). The cold-pressor test consists of submersion of the dominant hand and arm up to the elbow in a container of ice water. This procedure induces discomfort (or a pain sensation) through phasic vasoconstriction and vasodilation (Lewis, 1921).

In addition, Turkat and his associates (1983a; 1983b) have demonstrated the effects of exposure to models in a work environment using a finger pressure pain test. The finger pressure test is a procedure that induces pain when an individual places an index finger into a pressure apparatus. Subjects in these studies viewed a film of a model experiencing finger pain who either gave up a work task early (high-avoidant) or who worked for a considerable length of time but eventually gave in to the pain (low-avoidant). The findings indicated that subjects exposed to the high-avoidant model did significantly less work than subjects exposed to low-avoidant models when they were asked to perform the same task while exposed to finger pressure.

In accord with previous research on pain tolerance, the present study predicts that subjects exposed to tolerant models will endure a painful exercise longer than subjects who are exposed to an intolerant model or no model (control). In contrast, subjects exposed to an intolerant model will endure isometric-sitting for less time than those in the control and tolerant conditions.

Researchers have also investigated the effects of social influences on pain perception. Pain perception can be measured as pain threshold, or pain intensity. Weinsenberg (1977) defines pain threshold as the "point at which an individual first perceives the stimulation as painful" (p. 1013). Pain intensity is another measure of pain perception. Pain intensity is generally measured through the self-report of pain or the judgment of expressive pain behavior in others.

Pain rating scales have been devised by various researchers (Cabanac, 1986; Johnson & Cabanac, 1983; Prkachin & Craig, 1985) for use in experiments involving the self-report of pain intensity. Subjects are asked to rate the magnitude of pain they are experiencing by calling out pain estimates relative to the number one (pain threshold). If the pain is ten times greater than one, the subject reports 10. If subsequent pain is 100 times greater than the initial report of one, the subject says 100, and so on.

Researchers have also examined pain intensity through estimation of pain experienced by others (Patrick, Craig & Prkachin, 1986; Prkachin, Currie & Craig, 1983; Prkachin & Craig, 1985). In these experiments, subjects are exposed to painful stimuli and judges are asked to rate the intensity of pain the subjects are experiencing. Judgments are based on non-verbal expressive behaviors such as facial grimaces or muscle tension.

Current literature on pain perception indicates that the use of an individual cognitive strategy (such as goal specification, relaxation training, or exposure to information clarifying the effect of a drug) results in higher pain thresholds and decreased pain ratings in athletes and experimental subjects exposed to painful stimuli (Dworkin, Chen, Schubert & Clark, 1984; Gauron & Bowers, 1986; Thorn & Williams, 1989).

In addition, many researchers have reported the usefulness of combined strategies for increasing pain thresholds and reducing reported pain intensity in patients suffering osteoarthritic knee pain and experimental subjects exposed to cold-pressor pain (Avia & Kanfer, 1980; Berntzen, 1987; Grimm & Kanfer, 1976; Keefe, Caldwell, Williams, Gil, Mitchell, Robertson, Martinez, Nunley, Beckham, Crisson & Helms, 1990; Vallis & Bucher, 1986).

Social modeling is a particularly effective cognitive strategy used to influence pain threshold and pain ratings. Two early studies by Craig & Weiss (1971;1972) demonstrated that expressions of pain and discomfort could be influenced by observing confederate models who displayed high or low tolerance for electrical shock. Subjects' pain expressions and willingness to accept shocks matched the behavior of the tolerant and intolerant model. Subjects who observed tolerant models, showed less pain expressions, accepted higher shock levels and reported less discomfort than participants who observed intolerant models.

To determine if subjects' verbal and motor behaviors were simply a result of social demands to act in a favorable or unfavorable manner, Craig & Neidermayer (1974) examined whether subjects accepting high levels of shock before reporting pain (tolerant condition) were concealing more subjective discomfort than subjects describing low levels of shock as painful (intolerant condition). The study predicted that concealed discomfort would be identified through autonomic measures of skin conductance and heart rate. In accord with the two earlier studies, the results indicated that subjects exposed to tolerant models reported less pain and accepted higher levels of shock than subjects who described low levels of shock as painful. According to results for the autonomic measures, subjects exposed to tolerant models were not concealing discomfort from the observers. In other words, subjects accepting high levels of shock experienced no more discomfort than subjects who reported low levels of shock as very painful.

Craig and his associates (1975) also examined the psychophysical power functions describing the relationship between pain ratings and electric shock intensity to quantify the subjective experience of pain. The results indicated that tolerant subjects showed higher pain thresholds (by acceptance of higher intensities of shock), rated shocks as less painful and reported smaller units of change in pain on a ten-point pain rating scale than subjects exposed to intolerant models.

In accord with previous research, the present study predicts that social modeling affects pain perception as indexed by both pain threshold and intensity. Subjects exposed to tolerant models are expected to report higher pain thresholds and less change in the magnitude of pain experienced while performing a painful exercise than subjects in the intolerant and no model conditions. Subjects exposed to intolerant models are expected to report pain very early into the exercise (low pain thresholds) and to indicate greater changes in magnitude estimates of pain compared to tolerant and control subjects.

In addition, social modeling may affect physiological responses to a painful stimulus. Bandura (1986; pp. 307-323) noted that social models regulate pain in others by altering physiological and neurophysiological processes. For example, subjects exposed to tolerant models performing a painful exercise may show a slower change in heart rate than those exposed to others who cannot withstand the pain.

Physiological reactions in turn, may affect perceptions of pain. Studies have shown that inference of emotional states can be influenced by feedback on physiological measures such as heart rate even when this feedback does not correspond to actual autonomic arousal (Valins, 1966; Valins & Ray, 1967). Valins (1966) conducted an experiment in which male subjects were given false information on what they believed were their heartbeats while viewing slides of seminude women. Participants were asked to rate the attractiveness of each woman depicted in a slide. Results of the study indicated that pictures on which subjects thought their heartbeats increased or decreased markedly were rated as significantly more attractive by subjects than pictures on which no change occurred. Valins concluded that subjects based their attraction on physiological cues (change in heartbeats) correlated with arousal. In context of the present study, exposure to social models may influence heart rate that in turn may affect perceptions of pain and endurance of a painful exercise.

Bandura (1977a; 1977b; 1977c; 1977d) claimed that self-efficacy beliefs govern and predict behavioral change. Perceptions of self-efficacy influence an individual's belief in his or her ability to perform a task as well as one's persistence and final level of performance for that task. Recently, pain studies have shown a high correlation between self-efficacy and pain tolerance using a cold pressor test (Baker & Kirsch, 1991; Bandura, O'Leary, Taylor, Gauthier & Gossard, 1987; Dolce, Doleys, Raczynski, Lossie, Poole & Smith, 1986a; Litt, 1988).

Bandura (1977a; 1977b; 1977c; 1977d) suggests that all behavioral change is mediated through changes in self-efficacy. Research has already shown clear effects of modeling on pain behavior and studies have demonstrated a moderate to high correlation between self-efficacy and pain tolerance, it follows then, that if Bandura's theory of self-efficacy is correct, the effects of social modeling on pain endurance should operate through perceptions of self-efficacy to affect behavior. From this perspective, the use of models can be described as an indirect strategy for strengthening or weakening performance through perceptions of self-efficacy. Exposure to tolerant models should enhance self-efficacy and increase endurance for isometric-sitting, while exposure to intolerant models should decrease perceived self-efficacy and thereby inhibit performance. Previous research has not examined the indirect effects of social modeling on pain behavior through perceptions of self-efficacy.

Recent studies, however, have demonstrated how other cognitive strategies directly enhance self-efficacy ratings, which, in turn, correlate with greater pain endurance (Bandura, O'Leary, Taylor, Gauthier & Gossard, 1987; Baker & Kirsch, 1991; Dolce, Doleys, Raczynski, Lossie, Poole & Smith, 1986a; Vallis & Bucher, 1986). Taken together, the findings indicate that training in the use of cognitive strategies, (relaxation training, attention diversion, self-instruction,etc.), or providing incentives and performance quotas enhances perceived self-efficacy. The higher the self-efficacy rating, the longer subjects endure discomfort of a cold-pressor test.

The present study contributes new insight into pain research by examining the indirect effects of social modeling on endurance through perceptions of pain and self-efficacy. One possibility is that modeling works through pain perception processes to affect endurance. Subjects exposed to a tolerant model (as opposed to an intolerant model or no model) may show less change in heart rate, experience less pain and endure a painful exercise longer. Subjects exposed to intolerant models may show greater increases in heart rate, report more pain and give in to the pain quickly, relative to the other two conditions.

Alternatively, exposure to a tolerant model should enhance self-efficacy ratings, that in turn lower pain perceptions and ultimately result in longer endurance. Subjects exposed to an intolerant model may report lower self-efficacy ratings, perceive more pain and endure the task for a shorter length of time than subjects in the tolerant and control conditions.

Although the effects of modeling and reinforcement have been investigated separately within the realm of pain research, previous studies have not examined the combined effects of these contingencies. Monetary reinforcement and social modeling may have a combined effect on endurance for isometric-sitting. Subjects who are paid $2.00 per 20 seconds of exercise and observe models who endure pain may last longer than subjects who are paid less and witness models give in to pain early in the isometric exercise. In addition this study examines whether a combined effect of money and modeling operates through perceptions of pain and/or self-efficacy expectations to affect performance.

Preliminary Experiment

The present study is based on preliminary research (conducted in 1989) that examined the effects of social modeling and reinforcement contingencies on pain endurance using an isometric-sitting exercise. The 2x3 factorial experiment crossed 2 levels of social modeling (pain tolerant vs. pain intolerant) with 3 levels of reinforcement contingency (5, 25 and 125 cents for every 20 seconds of exercise). Thirty male volunteers aged 18-25 years were randomly assigned to one of the six experimental conditions resulting in N=5 subjects in each condition.

Subjects viewed two confederate actors who either endured a painful exercise (tolerant model) or who gave in to the pain (intolerant model). Rate of payment was manipulated by instructions. Subjects were informed that they would receive 5, 25, or 125 cents for every 20 seconds they endured the exercise. Subjects then performed the isometric-sitting exercise and were paid for their performance. Dependent variables included endurance, self-efficacy, pain threshold, pain estimates and change in heart rate.

Pain endurance was measured as the total number of seconds of isometric-sitting. For each subject, self-efficacy was categorized as performance efficacy and coping efficacy calculated from subjects' responses on a self-efficacy form. (See self-efficacy in the methods section for a more detailed explanation). Performance efficacy was the score obtained from the upper limit of the highest indicated interval of isometric tolerance checked divided by the number of indicated intervals. If a subject, for example, believed he could last 166-180 seconds, 180 was divided by 12 (the number of preceding intervals including 166-180) resulting in a performance efficacy of 15.

Coping efficacy was the confidence rating (or strength of belief) indicated at 90 seconds of exercise. If a subject indicated that he was 80% confident he could endure 90 seconds of isometric-sitting, his coping efficacy score would be 80.

Pain threshold was measured as the time to report the first pain (in seconds). Pain estimates were the individual pain ratings subjects reported at one minute of exercise. Finally, change in heart rate was the value obtained by subtracting the number of beats per minute at zero time (immediately upon taking up the isometric position) from those obtained at one minute of exercise.

The findings of this experiment indicated that exposure to pain-tolerant models resulted in greater endurance, higher self-efficacy ratings and less estimated pain at one minute of exercise. There was no main effect of payment and no interaction of the conditions.

Although modeling had an effect on self-efficacy, there was no direct association between efficacy scores and isometric endurance. The results, however, indicated a substantial negative correlation between change in pain and endurance (r= .85). The less change in pain a subject experienced (between zero and one minute of exercise), the longer he lasted. In addition, pain threshold, correlated with endurance (r= .36). The more time that passed before subjects first reported a pain sensation, the longer they endured the exercise.

A Critical Review of the Preliminary Experiment

In terms of sample size, the previous experiment used 30 subjects in 6 experimental conditions resulting in only N=5 per condition. The present study has a larger sample of N=90 subjects. In addition, the present experiment is a more complete design because it includes appropriate control conditions for the modeling and reinforcement manipulations.

The results of the preliminary experiment indicated that monetary reinforcement did not have an effect on any of the dependent measures. One interpretation for this finding is that the monetary reinforcement rates were not sufficiently motivating to the subjects. To investigate this possibility, the present study uses zero (control), \$1.00 and \$2.00 for every 20 seconds of endurance. In the \$2.00 payment condition, a subject can earn as much as \$36.00 for 6 minutes of exercise.

In addition, subjects in the preliminary study learned just prior to the exercise, that they would receive either 5, 25 or 125 cents for every 20 seconds of isometric-sitting. After completing the exercise and handing in their post-study questionnaires, they were given an additional payment of five dollars. To examine whether rate of payment might also affect self-efficacy, subjects in the present study learn about their rate of payment before completing the self-efficacy form. Following the videotape presentation, subjects who are randomly assigned to the zero payment (control) condition receive an envelope containing a five dollar bill for participation that is not contingent on their endurance. Subjects in the pay conditions also receive five dollars for participation as well as instructions indicating that they will receive either $1.00 or $2.00 for every 20 seconds that they endure the exercise. These subjects receive additional earnings when they complete the exercise.

Self-efficacy measures in the preliminary study included performance efficacy and coping efficacy. The efficacy measures were calculated from subjects' responses given on a questionnaire. The form consisted of 40-fifteen second intervals beginning with 0-15 seconds and ending with 586-600 seconds. Subjects were instructed to place a check mark in the blank space following each interval they felt they could endure the isometric exercise. Beside each interval, subjects rated their degree of certainty for performing the exercise at that level. Subjects circled one value on the certainty scale which ranged from 0 to 100 percent in 10 percent intervals.

The self-efficacy measures used in the preliminary study were arbitrary and insensitive resulting in concerns regarding validity. Performance efficacy in the preliminary study, for example, simply indicated the upper level checked on the efficacy form divided by the number of intervals to this point, without consideration of the subject's confidence at this level. A subject who was 10% confident at 180 seconds, for example, would have the same performance efficacy of 15 (180 divided by 12 equals 15) as one who indicated 90% confidence for 180 seconds.

Coping efficacy, on the other hand, measured only a subject's confidence in his ability to endure 90 seconds of isometric-sitting even though the form consisted of 40-fifteen second intervals beginning with 0-15 seconds and ending with 586-600 seconds. Ninety seconds (or the fifth interval out of a total of 40 intervals) was selected as the cut off point because all subjects endured the exercise for at least 90 seconds. This measure confined the analysis to one and a half minutes of exercise while discarding important information beyond this interval. A subject, for example, who reported 80% confidence for enduring 90 seconds of exercise would have a coping efficacy score of 80. The same subject may have been 80% confident he would last 240 seconds (or 4 minutes) but this information was disregarded in the preliminary study.

In accord with Bandura's (1977c) recommendations, the present study computed mean self-efficacy ratings for the entire set of endurance durations (40-fifteen second endurance intervals beginning with 0-15 seconds and ending with 586-600 seconds). Self-efficacy scores were computed by totalling all circled values for degree of certainty and dividing this number by 40 (the total number of intervals).

In addition, efficacy congruence between predicted and actual performance for 100%, 50% and the lowest confidence level indicated excluding zero was calculated. To obtain the degree of congruence between expected and actual performance at the 100% confidence level, for example, the following steps were necessary. First, the uppermost interval at 100% confidence was recorded. If a subject was, for example, 100% confident he would last 0-15, 16-

30, 31-45, and 46-60 seconds, the interval of 46-60 was recorded as his expected endurance. If the subject endured the actual exercise for 130 seconds, he exceeded his performance expectations at the 100% confidence level (for a more detailed explanation see dependent variables in Method section).

Heart rate is an important measure in the present study for two reasons. Any physical exercise entails a minimal medical risk. Monitoring heart rates every 20 seconds ensured that the subjects were not exposed to physical harm. In addition, heart rate is a physiological measure that may be affected by social influences such as social modeling and monetary payment. In turn, heart rate may affect perceptions of pain.

Change in heart rate in the preliminary study measured the difference between resting heart rate and heart rate one minute into the exercise. Again, this is an arbitrary measure that leaves out important information that may take place after one minute of exercise. This measure does not, for example, provide information about heart rates at final endurance times, particularly for subjects who last 3 minutes or more. The present study computed standardized slopes for change in heart rate over endurance time for each subject.

METHOD

Subjects

Ninety male volunteers between the ages of 18-25 years were recruited from a pool of undergraduate university students who agreed to participate in an experiment involving endurance and motivation. Subjects were randomly assigned to one of nine experimental conditions with N=10 subjects in each treatment group. The volunteers were informed that they would be paid for their participation and time. Subjects completed a brief application form assessing their need for money, level of exercise and overall health (see Appendix). All subjects in the study indicated at least some need for money and good cardiovascular fitness. In addition, applicants were asked if they exercised regularly and if so, how often and what types of exercise they performed. Participants who exercised on a daily basis were not selected for this study. Finally, subjects were asked whether they had ever done an isometric exercise and if so, how many times. Volunteers who specifically used isometric exercises in sports and fitness programs (ie., weight lifting or martial arts) or who exercised on a daily basis were omitted from this study.

Apparatus and Setting

Presentation of the videotaped models was conducted in a small experimental laboratory. The laboratory was equipped with a half-inch videotape recorder and television monitor. A table and chair were situated in front of the monitor to allow the subjects to fill out forms and watch the recorded material. Forms included a participation form, a pre-study questionnaire and a self-efficacy instrument (see Appendix).

A larger laboratory was divided into experimental and instrument control rooms. The control room had electronic programming by Colbourne Instruments. A hand-held switch with a long extension cord was strung between the control equipment and the experimental room. Subjects were taken to the experimental room where they pressed the switch to start the experiment and released it when they first felt a pain sensation. These actions started the endurance timer and stopped the pain threshold timer, respectively.

In addition, the experimental room was equipped with a wooden box containing a pressure plate. The box was a 2-foot cube and the pressure plate was affixed to the top. When subjects could no longer withstand the isometric exercise, they collapsed onto the pressure plate. This response depressed the plate and a shaft activated a microswitch. The pulse from this microswitch was used to stop the experiment and the endurance timer. Subjects reported pain estimates every 20 seconds until they could no longer endure the pain of the exercise. A Polar Vantage heart rate monitor was used to measure heart rate and these values were also recorded every 20 seconds.

Finally, the experimental room was also equipped with a table and chair for filling out post-study questionnaires (see Appendix) following the exercise and allowing the subjects time to rest after their performance.

Procedure

Scheduling Participants. Each subject was contacted by phone and scheduled for a one hour session (see Appendix for application form and telephone interview). Volunteers who indicated that they had not had a medical exam within the last year were encouraged to visit a physician prior to their scheduled session to ensure that they were fit to participate in the study. Subjects were asked to wear loose, unrestricted clothing or gym wear. Upon arrival for the session, subjects were greeted by a female researcher (E1) and taken to the small laboratory. Subjects were seated at a table in front of a television monitor and asked to carefully read a participation form that provided consent for participation in the study.

Participation agreement. ***The participation form*** (see Appendix) indicated that the subject agreed to perform an isometric-sitting exercise and accepted the minimal medical risks involved in the performance of a physical exercise. The statement ensured that participation was voluntary and that subjects were free to withdraw from the study at any time. In addition, this form acknowledged that information pertaining to individual subjects would be kept strictly confidential by the researchers. The statement also specified that published data would not include any direct references to individuals participating in the study and that research findings would be reported as anonymous or case data. After subjects signed the participation form, they were asked to complete a ***pre-study questionnaire*** (see Appendix).

Pre-study Questionnaire. This form assessed ***performance expectations*** (involving how long, for example, the subject believed he would endure the isometric exercise expressed in minutes and seconds) as well as confidence in his ability to endure this period of time expressed in confidence ratings of 0-100 with 10% intervals. After completing the pre-study questionnaire, all subjects were asked to watch one of nine standardized presentations on videotape. Subjects viewed the videotapes in the small experimental room to ensure that the second experimenter (who remained in the large lab where the test occurred) was blind to the modeling condition assigned to each subject.

Social Modeling Manipulation. The videotapes presented instructions and a demonstration of the isometric-sitting exercise. All tapes had been recorded in the large laboratory where the actual test occurred. On each tape, a male research assistant (E2) explained the task to an experimental confederate posing as a previous subject.

The experimenter (E2) explained to the actor that the study concerned endurance and motivation. Based on instructions provided in the videotapes, subjects learned that they were to perform an isometric-sitting exercise. The videotapes allowed for the manipulation of social modeling. For subjects in the ***no social modeling*** (control) condition, the videotape presentation provided instructions on how to perform the isometric-sitting exercise. The confederate was shown listening to the instructions but he did not attempt the exercise. The experimenter told the confederate that he would take an unsupported position against a wall with his thighs parallel to the floor and lower his legs to a 90 degree angle. The experimenter (E2) then explained to the confederate that a hand-held switch would be given to him and when the researcher said go, he should press the switch. The actor was told to release the switch (by dropping it to the floor) when he felt pain for the first time. Finally, the confederate was asked to position himself over the box with a pressure plate and told to sit down on the box when he was ready to stop the experiment. The experimenter then asked the confederate if he had any questions and the actor briefly summarized the instructions.

The videotape also indicated to the subjects other aspects of the study. Participants were told that they would be required to remove their shirts, wear a heart-rate monitor, and estimate their pain every 20 seconds. The experimenter (E2) told the confederate that as soon as he felt the first sensation of pain, he was to drop the hand switch and call out the number one. All subsequent pain was estimated by assigning numbers relative to the first value. If the pain was ten times greater he was to call out the number 10 and if it was 100 times worse, he should report 100 as the value.

Once the confederate received all necessary instructions involving the exercise and all of his questions had been answered, the experimenter asked the actor to remove his shirt. To ensure that the length of tapes and video presentations were similar across conditions, the control tape then portrayed a still-shot of the confederate in the isometric position. Audio-dubbing was used to provide a voice-over that briefly summarized the instructions. The viewer was told that "this is a subject from a previous session" and to "note that the subject is in a sitting position above the box containing the pressure plate." The voice-over also pointed out that "the subject is holding the hand switch that he will release it when he feels the first instance of pain." The viewer was then reminded to "report the level of pain you are experiencing following the beep that sounds every 20 seconds."

Another confederate was then shown on the video and the voice-over continued to summarize the instructions. The voice-over explained that "this is another subject from a previous experiment." The viewer was told to "note that a heart rate monitor is hooked up around his chest area." The voice then explained that "following the beep sound, the experimenter will record the subject's heart rate." Finally, the tape ended with a reminder to "sit down on the box to end the session."

Subjects who were randomly assigned to the ***intolerant-model condition*** saw the videotaped instructions as well as a live demonstration of the exercise. These subjects saw a male confederate seated in the large experimental room with two research assistants (E2 and E3). The experimenter (E2) read out instructions to the confederate (as stated above) and then asked the person to remove his shirt. A heart-rate monitor was attached around the confederate's chest. Next, E2 helped the confederate take up the exercise position against the wall and gave him the hand-held switch. One experimenter called out the heart-rate values (E2) and the other (E3) recorded these scores and the estimates of pain every 20 seconds.

The confederate acted the intolerant-model role according to a script. The script called for the actor to collapse onto the pressure plate after 60 seconds. When E2 said "go," a timer in the upper portion of the television screen was activated and an audio "beep" occurred every 20 seconds. Cue cards were used to tell the confederate what pain estimates to call out and what signs of pain to display. Pain was displayed by facial expressions, grimaces, moans, clenched teeth and hands, and shaking legs. The confederate dropped the hand switch and called out the pain estimate of one (threshold) at 10 seconds into the exercise. After 60 seconds, he collapsed calling out 100 as the final pain estimate. The videotape showed him moaning and rubbing his thighs.

In order to add credibility and to generalize the intolerant-modeling effect, a second confederate also portrayed the isometric exercise. Again, this actor behaved according to the script but, in this case, he collapsed after 80 seconds. Subjects saw the actor drop the hand switch at 15 seconds and call out the first pain estimate of one. In order to avoid suspicion, his estimates were twice the value of the first model and increased to 200 by the end of the exercise.

A similar procedure was used to create the ***tolerant-model condition*** with the same confederates appearing in the video. Again, following the instructions, subjects observed the actor performing the isometric-sitting exercise. In order to make sure the confederate lasted the required time and presented the signs of pain on cue, a small wooden seat was created in the form of the letter "T". The actor sat on the top of the seat and the shaft was camouflaged to blend into the color of the wall. Editing ensured that this presentation was realistic to the observer.

In the tolerant-condition, the first actor did not report pain (threshold) until 40 seconds into the exercise. His pain estimates increased from 1 to 100 as in the intolerant-condition, but the pain estimate of 100 was reported at 240 seconds, as the confederate collapsed onto the pressure plate.

The same script of pain expressions was followed as in the intolerant-condition, but it took much longer for the signs of pain to occur. Again, as he collapsed onto the plate, the confederate moaned and rubbed his thighs. Following this performance, the second confederate was presented on the videotape. In order to maintain credibility, this actor reported pain after 60 seconds and his pain estimates increased from 1 to 200 in value, as in the intolerant-condition. His pain expressions were matched to the duration of isometric-sitting and he collapsed moaning and rubbing his thighs at 260 seconds into the exercise.

Thus, ninety subjects were randomly assigned to observe one of three social modeling conditions (tolerant, intolerant and no model). There were N=30 subjects in each modeling condition.

Monetary Reinforcement Manipulation. Following the videotape presentation subjects were given an envelope with a ***rate of payment*** written on an enclosed piece of paper and a five dollar bill. To ensure that performance was not contingent on the flat fee of $5.00 for participation in the experiment, subjects were paid the mandatory fee prior to the isometric task.

Subjects who were randomly assigned to the ***zero payment*** condition received an envelope containing a five dollar bill and a slip of paper stating that the five dollar payment is enclosed in this envelope. These subjects did not receive any additional instructions regarding monetary incentive. The subjects were then asked to take note of the payment but not to reveal this amount to the experimenter in the room where the test was conducted. This procedure ensured that the research assistant (E2) was blind to the rate of payment assigned to each subject.

Participants who were randomly assigned to the ***$1.00 payment condition*** received an envelope containing a five dollar bill and a slip of paper stating that this is your $5.00 participation fee. The statement then added that "you will receive an additional payment of $1.00 for every 20 seconds that you endure the isometric-sitting exercise." Thus, the additional payment of $1.00 per 20 seconds, was contingent on the subject's isometric performance.

The same procedure was used to instruct subjects in the ***$2.00 payment condition***. The envelope contained a five dollar bill and a statement claiming that this is your payment for the session. This statement informed the subject that he would receive an additional $2.00 per 20 seconds of exercise.

All ninety subjects, then, received five dollars for their participation. In addition, subjects were randomly assigned to one of three payment conditions (zero, $1.00 and $2.00 per 20 seconds of exercise). There were N=30 subjects in each pay condition.

Self-Efficacy Ratings. After subjects read the statement depicting the monetary reinforcement conditions, they were asked to complete a ***form assessing self-efficacy*** (see Appendix). Instructions asked subjects to rate their perceived ability to perform the isometric exercise measured as level of endurance ranging from 0-600 seconds in 15-second intervals. An upper limit of 600 seconds was set since most males cannot last this long without explicit training. Beside each interval, there was a certainty scale that ranged from 0 to 100 percent. Subjects were instructed to rate their degree of certainty regarding each level of performance. Subjects were asked to check each interval they felt they could complete and circle the degree of certainty for that interval.

Upon completion of the self-efficacy form, subjects were once again reminded not to reveal their rate of pay to the experimenter conducting the isometric exercise. E1 then escorted the participants to the large experimental laboratory to conduct the isometric-sitting test.

Isometric Sitting Exercise. Subjects were greeted by the second experimenter (E2) and E1 left the room. E2 then asked each subject to remove his shirt and proceeded to attach the heart-rate monitor to the subject's chest. Next, a measure of resting heart was taken. After a brief review of the instructions, E2 positioned the subject in the isometric squat to ensure maximum tension on the thighs. The participant was given the hand switch and as soon as the subject achieved the correct position, E2 said "go."

At this point, subjects pressed the hand switch and held it down until they felt the first sensation of pain. When pain was detected, subjects dropped the switch and reported the number one. An audio beep occurred every 20 seconds and pain estimates and heart-rate measures (see Appendix) were recorded by the same experimenter. In the video tape, one experimenter called out the heart rates (E2) and another assistant (E3) recorded them. To prevent distractions that may have resulted from calling aloud the heart rates, this procedure was eliminated in the actual experiment. There was only one experimenter in the room during the isometric test. This experimenter (E2) recorded the heart rate and pain estimate every 20 seconds. The experiment stopped when the subject sat down on the box and activated the pressure plate.

Post-Study Questionnaire. Upon completion of the isometric-sitting exercise, all subjects were given a two-part ***post-study questionnaire*** (see Appendix). The experimenter asked the subject to have a seat at the table and the first part of the questionnaire was distributed. Subjects completed the first section and submitted it to the experimenter before they received the second part of the questionnaire. This procedure enabled the subject to report initial impressions of the study. Leading questions in the second portion of the questionnaire would have biased this reporting.

The first section of the questionnaire asked how long the subject believed he endured the exercise (in minutes and seconds). Participants gave general impressions regarding the study, as well as what they believed the purpose of the study was. Subjects were then asked if the purpose (as they perceived it) affected their performance and if so, how.

On the second part of the post-study questionnaire, subjects stated the most important source of motivation for their participation in the study (ie., competitiveness, self-esteem, money, etc.). Subjects commented on their endurance time in relation to the money they received as well as the intensity of pain reported in relation to the money received. Subjects were then asked to recall how long the model (if they were exposed to one) endured the exercise (in minutes and seconds). They also reported how many seconds passed before the model first reported pain. Subjects stated whether the model affected how long they maintained the exercise, and whether the videotape affected the intensity of pain they experienced and if so, how. Finally, the participants were asked to guess the hypotheses pertaining to the study.

Additional Payment. The subjects gave their completed forms of the second portion of the post-study questionnaire to the experimenter. At this time, E1 entered the room and asked the subject to sign a pay form indicating the payment received by the subject. Subjects in the money conditions, were given an envelope containing the additional payment owed for each 20 second interval the subject endured the exercise.

Debriefing. E1 then gave each subject a hand-out indicating the scheduled date and time of three debriefing seminars. Subjects were informed that they could attend any one of these three seminars to find out about the study and their role as participants. In addition, subjects were told that they would be given a report that summarized the main findings of the study at this time. The experimenter (E1) then explained that letters containing the same information would be sent to individuals who were unable to attend one of the three sessions. The experimenters then thanked all the subjects for their participation in this study and showed them to the exit.

Design

The design for this experiment was a 3x3 factorial analysis of variance. There were three levels of monetary reinforcement: zero payment (control), $1.00 and $2.00 (per 20 seconds of endurance). The three levels of social modeling included: no model (control), an intolerant model, and a tolerant model condition.

Dependent Variables

A number of dependent measures were collected in this study. ***Endurance*** was measured as the total number of seconds (also expressed in minutes) of isometric sitting. ***Pain threshold*** was the number of seconds to the first report of pain following the experimenter's command to "go."

Change in pain rating indicated how quickly estimates of pain (reported every 20 seconds) increased over time (in minutes). Magnitude estimates for pain ratings varied across subjects. In order to standardize the pain estimates, the ratings for each subject were expressed as Z-scores. The slope of time regressed on these standardized pain scores was then calculated for each subject. These standardized slopes were used to indicate the change in pain rating.

Change in heart rate indicated how quickly heart rate (recorded every 20 seconds) rose over time (in minutes). The slope for the rise in heart rate over time was calculated for each participant with regression analysis. The heart rate slopes were then used to indicate change in heart rate.

Self-efficacy for each subject was the score obtained by adding all the circled confidence ratings and dividing by the total number of intervals on the self-efficacy form (see Appendix). The self-efficacy form consisted of 40-fifteen second endurance intervals beginning with 0-15 seconds and ending with 586-600 seconds. Subjects put a check mark in the blank space following each interval they felt they could endure the isometric exercise. Beside each checked interval, subjects rated their degree of certainty for performing the exercise at that level. Subjects circled one value on the certainty scale. The degree of certainty scale ranged from 0 to 100 percent with 10 percent intervals. Self-efficacy scores were computed by totalling all the circled values for degree of certainty and dividing this number by 40 (the total possible number of intervals).

Efficacy Congruence was measured as the degree of congruence between expected endurance (in 15 second intervals) and actual endurance. Efficacy congruence was calculated for three levels of confidence (100 percent, 50 percent and the lowest confidence rating excluding zero). To obtain the degree of congruence at the 100 percent confidence level, for example, several steps were necessary. First, the uppermost interval indicated by the subjects on the self-efficacy form at 100 percent confidence was recorded. If a subject indicated that he was 100% confident he would last 0-15 seconds, 16-30 seconds and 31-45 seconds, the highest interval (31-45 seconds) was recorded. If this subject's actual endurance for isometric-sitting was 45 seconds, his performance expectations were in agreement with his actual performance. If the same subject endured the exercise for 120 seconds, he exceeded, but still met his performance expectations at the 100% confidence level. The same prodedure was used to calculate congruence between expected and actual performance at the 50% and last indicated confidence interval excluding zero.

Congruence for the 50% confidence level was measured as the uppermost interval at 50% or the next closest confidence level less than this value if 50% confidence was not indicated on the self-efficacy form. If a subject, for example indicated that he was 60% confident he would last 181-195 seconds and 40% confident that he would last 166-180 seconds, the interval for 166-180 seconds would be recorded as the 50% confidence level. Two subjects did not report confidence ratings that could be interpreted by this procedure for 50% confidence and were not included in this analysis.

Congruence for the last (or highest) indicated interval and actual endurance was calculated in the following manner. A subject indicated that he was 5% confident he would last 91-105 seconds, 106-120 seconds, and 0% confident he would last 121-135 seconds and all intervals above this. The interval of 106-120 seconds was recorded as the last confidence interval for this subject.

The second step was to calculate the total congruence for the three confidence intervals by modeling condition. Three confidence intervals were determined for all 90 subjects. For each subject, agreement between expected and actual endurance was given the value of one and disagreement was given the value of zero. There were N=30 subjects in the three modeling conditions (intolerant, control and tolerant). For each modeling condition, the congruence scores were summed for each confidence interval. This resulted in a score out of 30 for 100%, 50% and the lowest indicated confidence level for the three modeling conditions. For example, 29 out of 30 subjects in the tolerant modeling condition endured the isometric-sitting exercise to the level indicated at 100% confidence.

Finally, degree of congruence between expected and actual endurance was obtained by dividing the total for agreement by the total possible score for each confidence level by modeling condition. The degree of congruence for subjects in the tolerant condition is 29 out of 30 or 96.7% at the 100% confidence level.

RESULTS

Suspicion and Manipulation Checks

The post-study questionnaire was used to check on suspicion and evaluate the adequacy of the experimental manipulations. The first part of the questionnaire asked subjects whether they formed any specific ideas about the study and whether these ideas affected their performance. Subjects were coded as suspicious if they, for example, indicated that they "believed the purpose of the study was to see if subjects would last as long as the people on the tapes" or if they suggested that the modeling tapes were fabricated or unrealistic in any way. Only 2 of 90 subjects (2.2 percent) were suspicious of the tapes (one in the tolerant/$2.00 condition and the other in the intolerant/no money condition).

To determine the impact of suspicion on the findings of this study, two separate analyses (one with all of the subjects and one that excluded the two suspicious subjects) were conducted on each of the dependent variables. Because the results did not differ for the two separate analyses, findings were subsequently reported for the entire subject sample.

In order to check on the social modeling manipulation, subjects were asked to recall (in minutes and seconds) how long (if indicated by the tape) the actors in the training tape endured the isometric-sitting exercise. All subjects in the control condition correctly stated that the information was not given on the tape. All 30 subjects in the intolerant condition (100 percent) correctly identified the durations portrayed in the tape. Only 16 out of 30 subjects (53.3%) in the tolerant condition gave the exact duration for the models. Subjects who gave incorrect responses tended to underestimate the confederates' endurance. To determine if estimates reported for endurance of confederates reflected subjects own endurance times rather than the times portrayed in the modeling tapes, endurance was regressed onto estimated endurance for the confederates. The results indicated a correlation ($R= .56$) between actual endurance and estimates of endurance for the confederates, $F(1,58)= 26.43$, $p= .0001$.

To examine the impact of this manipulation check, two separate analyses (one that includes all tolerant subjects and one that includes only those who correctly indicated the actors endurance times) were conducted for each of the dependent variables. Except for the endurance measure, the pattern of the means for the total sample and the reduced sample (excluding those who gave inaccurate reports for the models' endurance) were identical. Findings for the reduced sample were not always significant at the p=.05 level due to less degrees of freedom and changes in the sums of squares for each factor. Because of this, only the results for the endurance measure are reported for the reduced sample.

Finally, subjects were asked to indicate the "most important source of motivation for you in the study." Although subjects were instructed to base their isometric performance on money, and were selected for participation on the basis of their stated need for money ("quite a lot" or "desperately"), only 49 out of 90 subjects (54.4 percent) reported being motivated by the money. Most of the other subjects (37 out of 90 or 41 percent) indicated that competitiveness was the important factor.

Endurance

One main effect was revealed by the analysis of variance for monetary payment and social modeling on endurance time for the total sample. Modeling had a significant effect on endurance, F(2,81) = 13.76, p < .001 (see Figure 1). Subjects in the tolerant condition (M = 4.12 minutes, S.D. = 1.25) lasted longer than subjects assigned to control (M = 3.10 minutes, S.D. = 1.12.) and intolerant (M = 2.69 minutes, S.D. = 0.88) conditions.

Figure 1 about here

A Student-Newman-Keuls procedure was used to determine critical differences between conditions by post-hoc pairwise comparisons of the means at the $p = .05$ level. The intolerant modeling condition differed significantly from the tolerant condition on endurance, but did not differ from the control group. There was also a significant difference between the control and tolerant groups.

There was no main effect of monetary payment on endurance, $F(2,81) = 0.23$, n.s. In addition, there was no interaction effect of modeling and monetary payment on endurance, $F(4,81) = 1.58$, n.s.

The analysis of variance for monetary payment and social modeling on endurance for the ***reduced sample*** (excluding tolerant subjects who could not identify how long the models in the tape lasted) revealed a main effect of modeling, $F(2,67) = 10.44$, $p < .001$. This result is the same as that found when all tolerant subjects were included in the analysis. The reduced sample of tolerant subjects endured the exercise for $M = 4.34$ minutes, S.D. = 1.41 (compared to $M = 4.12$ minutes, S.D. = 1.25 when all tolerant subjects were included). As in the total sample, there was no main effect of monetary reinforcement on endurance for the reduced sample, $F(2,67) = 0.88$, n.s. However, the analysis revealed an interaction effect for modeling and rate of pay on endurance, $F(4,67) = 2.63$, $p < .05$ for the reduced sample. Figure 2 shows the pattern of results.

Figure 2 about here

In order to interpret the interaction effect, a series of planned contrasts that compared cell means were computed. Overall, the first series of comparisons indicated no difference in mean endurance times between modeling conditions for subjects in the zero pay (control) condition. There was no difference in the means for tolerant compared to control subjects, F(1,67) = 0.20, n.s. and for tolerant and control compared to intolerant subjects, F(1,67) = 2.16, n.s.

For subjects in the one dollar condition, mean endurance times are not significantly different for subjects in the intolerant and control conditions, F(1, 67) = 0.08, n.s. The mean endurance for tolerant subjects in the one dollar pay condition, however, differed from the intolerant and control subjects in the same pay condition, F(1,67) = 24.77, $p < .001$.

The results for a series of planned comparisons for mean endurance times in the two dollar pay condition closely resembled the findings for the one dollar pay condition. The means did not differ between the control and intolerant groups, F(1,67) = 0.33, n.s. While the mean endurance time for subjects in the two dollar condition differed between the intolerant and control groups compared to the tolerant model condition, F(1,67) = 7.34, $p < .01$.

Taken together, the results for the contrasts indicate that the tolerant model condition accounts for the interaction effect of money and modeling on endurance for isometric-sitting. A final contrast compared the mean endurance times for subjects in the tolerant condition who were paid one dollar or two dollars. There was no significant difference between these two groups, F(1,67) = 2.04, n.s.

To interpret the pattern of results indicated by the series of planned comparisions, a one-way analysis of variance was conducted for rate of pay on endurance for the tolerant condition and the results were examined using polynomial contrasts. The results indicated a quadratic trend for rate of pay on endurance, F(1,13) = 4.73, p = .05 for tolerant subjects who correctly identified how long the models in the tape lasted.

Pain Threshold

The analysis of variance for the effects of monetary payment and social modeling on pain threshold revealed a main effect of modeling, F(2,81) = 9.90, p < .001. Post-hoc comparison of means using a Student-Newman-Keuls procedure showed that the mean pain threshold for subjects in the intolerant condition (M = 21.57 seconds, S.D. = 12.33) differed significantly from the tolerant (M = 39.83, S.D. = 19.06) and control (M = 38.60, S.D. = 20.81) conditions, p = .05. Figure 3 portrays this effect.

Figure 3 about here

There was no main effect of monetary payment on pain threshold, F(2,81) = 0.92, n.s. There was also no interaction effect of modeling and monetary payment on pain threshold, F(4,81) = 1.06, n.s.

Change in Pain Ratings

Analysis of variance was conducted on the slopes representing a standardized unit for change in pain ratings. There was one main effect of social modeling on the standardized slopes of the pain estimates, $F(2,67) = 5.56$, $p < .01$. Post-hoc comparison of the means using a Student-Newman-Keuls procedure indicated that the tolerant-model condition accounts for the effect of social modeling. The mean for change in pain ratings for subjects in the tolerant model condition differed significantly from the intolerant and control groups at the $p = .05$ level. Figure 4 reveals the pattern of results.

Figure 4 about here

Slopes of the standardized pain ratings for subjects who were exposed to tolerant models rose more slowly over time ($M = 0.99$) than did the pain ratings for subjects in the intolerant ($M = 1.46$) and control ($M = 1.40$) conditions. There was no main effect of monetary payment on change in pain ratings, $F(2,81) = 0.12$, n.s. and no interaction effect of modeling and monetary payment, $F(4,81) = 0.78$, n.s.

Change in Heart Rate

In general, heart rates increased over time for all the subjects. An analysis of variance was conducted for social modeling and monetary reinforcement on the slope for heart rate. There was a marginal effect of modeling on the heart rate slopes F(2,81) = 2.75, p = .07.

Inspection of slopes for individual subjects revealed two negative slopes. The two subjects with negative heart rate slopes were considered to be exceptional cases and these slopes were omitted from a subsequent analysis of variance. The results then showed that modeling had a significant main effect on the slope for heart rates over time, F(2,79) = 3.34, $p < .05$. Figure 5 depicts this effect.

Figure 5 about here

A Post-hoc analysis of the means using a Student-Newman-Keuls procedure indicated that the intolerant-modeling condition accounts for this effect. The slopes for subjects who are exposed to an intolerant model (M = 13.10, S.D. = 8.41) were significantly higher than those in the tolerant (M = 8.92, S.D. = 4.05) and control conditions (M = 9.69, S.D. = 6.25), p = .05. Heart rates increased more rapidly for subjects in the intolerant condition. There was no effect of money on change in heart rate, F(2,79) = 0.24, n.s. In addition, there was no interaction effect of social modeling and monetary reinforcement on change in heart rate, F(4,79) = 0.38, n.s.

Self-Efficacy

The analysis of variance for monetary payment and social modeling on self-efficacy revealed a main effect of social modeling, F(2,81) = 17.92, $p < .001$. Post-hoc comparison of the means using a

Student-Newman-Keuls procedure showed that subjects in the intolerant condition had significantly lower self-efficacy scores (M = 13.54, S.D. = 7.68) than subjects in the tolerant (M = 29.78, S.D. = 9.37) or control conditions (M = 28.29, S.D. = 15.63), p = .05. The pattern of results is shown in Figure 6.

Figure 6 about here

There was no main effect of money F(2,81) = 1.13, n.s. There was no interaction effect of modeling and monetary reinforcement on self-efficacy, F(4,81) = .78, n.s.

Efficacy Congruence

The results for degree of congruence between expected and actual endurance for each level of confidence are shown in Table 1.

Table 1 about here

The degree of congruence between expected and actual performance decreased as level of confidence decreased. Subjects in the intolerant conditon had the highest degree of congruence at all confidence levels.

Analysis of variance was used to determine if modeling or rate of pay had an effect on expected performance at 100%, 50% and the lowest interval indicated on the self-efficacy form. The results show a main effect of modeling on expected performance at 100%, F(2,81) = 10.17, p < .001; 50%, F(2,81) = 16.76, p < .001 and the lowest confidence level checked, F(2,81) = 22.49, p < .001. Table 2 portrays the mean expected endurance times for the three modeling conditions at each level of confidence.

Table 2 about here.

Post-hoc comparisons of the means using a Student-Newman-Keuls procedure indicates that the intolerant condition differs significantly from both the tolerant and control groups at the p = .05 level for all three confidence levels. The control and tolerant conditions do not differ significantly in the 100%, 50% or lowest confidence level.

Path Analysis

To determine if the effects of social modeling on endurance were mediated by self-efficacy or by pain perception, a path analysis using multiple regression procedures was conducted. Path analysis is a procedure used to examine causal relations based on prior assumptions about a set of variables. Figure 7 depicts the theoretical model for this experiment.

Figure 7 about here

The procedures of this study dictated the ordering of the variables. The social modeling variable consisted of three categories: intolerant, control and tolerant. The ANOVA results indicated that the effects of social modeling differ according to condition. For this reason, the modeling variable was treated as two dummy variables, intolerant and tolerant, with the control group as a reference category. A correlation matrix was computed using all of the variables and this matrix portrays the direct or bivariate relationships among each of the variables in this study (see Table 3).

Table 3 about here

A series of multiple regressions was used to estimate the direct and indirect effects of the variables depicted in the theoretical model. The first multiple regression computed the effects of all of the independent variables: social modeling, self-efficacy, pain threshold, change in pain, and change in heart rate on endurance (the dependent variable). The second analysis regressed tolerant, intolerant, pain threshold and self-efficacy, (the predictor variables) on heart rate (dependent variable). In a third analysis, tolerant, intolerant, pain threshold and self-efficacy were regressed on change in pain. For the fourth multiple regression equation, pain was regressed on the independent variables: tolerant and intolerant. Finally, self-efficacy was regressed on the dummy variables for the modeling conditions. The path model in Figure 8 shows the standardized coefficients for the direct effects among the variables.

Figure 8 about here.

The results shown in this path model lend further support to those obtained by the ANOVA procedures indicating that the effects of social modeling on endurance differ according to modeling condition. Social modeling in the intolerant condition does not have a direct effect on endurance. Modeling for this condition operates through pain threshold to affect endurance. In addition, the intolerant modeling condition directly affects self-efficacy ratings.

Social modeling for the tolerant condition has a direct effect on endurance as well as an indirect effect through change in pain. In addition, change in pain is directly affected by change in heart rate. Table 4 illustrates the decomposition of correlations for all the possible bivariate relationships among these variables using standardized coefficients.

Table 4 about here

To estimate these relationships more precisely, multiple regression equations were calculated for the two separate modeling effects shown in Figure 8. In the first equation, endurance was regressed on pain threshold, self-efficacy and the intolerant modeling condition. In the second equation, endurance was regressed on change in heart rate, change in pain and the tolerant modeling condition. The two refined path models in Figure 9 show the unstandardized and standardized coefficients for the direct effects of the variables by modeling conditions.

Figure 9 about here

The path model depicting the intolerant condition clearly shows that exposure to an intolerant model negatively affects self-efficacy ratings, but these ratings do not have a direct or indirect effect on any of these variables. In addition, exposure to an intolerant model has a negative effect on pain threshold. Pain threshold positively affects endurance and mediates the indirect effect of modeling on endurance.

The second path model depicts the tolerant model condition. This path diagram indicates that exposure to a tolerant model has a positive direct effect on endurance for isometric-sitting and a negative effect on change in pain rating. Heart rate positively affects change in pain rating and change in pain rating negatively affects endurance time.

DISCUSSION

Pain Endurance

Social modeling is an important determinant of pain endurance. In accord with previous research (Bandura, Adams, Hardy & Howells, 1980; Craig, 1986; Craig & Neidermayer, 1974; Craig, Best & Ward, 1975; Patrick, Craig & Prkachin, 1986; Prkachin & Craig, 1985;

Pkrachin, Currie & Craig, 1983; Thelen & Fry, 1981; Turkat & Guise, 1983a; Turkat, Guise & Carter, 1983b), the present study indicates that tolerant models increase subjects' endurance for isometric-sitting while intolerant models decrease endurance relative to no-model controls.

The findings show an interaction effect between modeling and rate of payment on endurance for the ***reduced sample*** (excluding subjects in the tolerant condition who did not accurately report how long the models in the videotape lasted). Subjects exposed to a tolerant model endured the pain longer when they were paid to do the exercise. For this condition, there was no difference between the $1.00 and $2.00 contingencies suggesting that the utility of money decreased when pitted against pain (Johnson & Cabanac, 1983; Cabanac, 1986). Monetary payment had no effect on subjects in the intolerant condition. When social modeling suggested a low standard of performance, monetary reward did not increase subjects' endurance.

One explanation for the different effects of money in the intolerant and tolerant modeling conditions concerns performance standards and quotas. Quotas have been successful in increasing exercise levels and expectancies of capabilities in chronic pain patients (Dolce, Doleys, Raczynski, Lossie, Poole & Smith, 1986a). In addition, quotas have proven to be effective in increasing endurance for a cold pressor test (Dolce, Crocker, Moletteire & Doleys, 1986b) and an ischemic pain test (Thorn & Williams, 1989).

The social modeling manipulation in this study may provide a standard level of performance from which subjects can assess their accomplishment of the isometric exercise. The confederates' endurance for the intolerant and tolerant modeling conditions set low (60-80 seconds) and high (240-260 seconds) standards for isometric sitting. Monetary reward increases endurance only when a high level of performance is set by the model. For subjects in the intolerant modeling condition, exposure to low endurance standards overrides the incentive provided by money.

According to path analysis, social modeling indirectly affects endurance through pain perceptions. The indirect effects differ according to modeling condition. Subjects exposed to intolerant models report low pain thresholds and these thresholds mediate the effect on endurance. Subjects exposed to tolerant models, on the other hand, report less change in pain ratings and this measure of pain perception mediates subjects' performance times for the painful exercise.

Pain Threshold

Social modeling had a significant effect on pain threshold. After exposure to intolerant models with low pain thresholds, subjects report feeling the first sensation of pain sooner than subjects in the tolerant and control conditions. Exposure to tolerant models in this study did not increase pain thresholds above those found in the control condition.

Craig & Neidermayer (1974), found significant differences in pain thresholds for electric shock by modeling conditions. The results showed much higher pain thresholds for subjects exposed to a tolerant models compared to no-model, a noncontingent model or an intolerant model. Subjects in the intolerant condition had significantly lower pain thresholds than subjects in the two control conditions (which did not differ) and participants in the tolerant condition.

The refined path analysis for subjects in the intolerant modeling condition indicated the role of pain threshold in mediating the effect of modeling on endurance. Exposure to the intolerant model decreases pain threshold which in turn leads to less endurance of pain. Observing others who cannot withstand the pain of exercise (intolerant condition), makes people quickly perceive the onset of their own discomfort. In other words, these subjects also report pain very early in the exercise. The higher the pain threshold (or time before pain is experienced), the longer the endurance for the painful exercise.

Change in Pain Ratings

In terms of change in pain ratings, the findings show that exposure to tolerant models results in a moderate rise in the magnitude of pain rating over time. The pain reports relative to the first sensation of pain (pain threshold) for tolerant subjects increase at a slower rate than pain reports given by subjects in the intolerant and control conditions.

The refined path analysis for subjects in the tolerant modeling condition indicates that change in pain mediates the effect of modeling on endurance. Exposure to a tolerant model negatively affects change in pain ratings which in turn negatively affects endurance. This finding suggests that when pain ratings increase, endurance for the pain becomes more difficult. Subjects who are exposed to tolerant models report less change in pain and this translates to greater endurance for the painful exercise.

Similar findings are reported by Thorn and Williams (1989) in a study that examined the effects of goal specification on perceived pain intensity and tolerance using an ischemic pain test. An ischemic pain test involves stopping blood flow to an arm by use of a pressure cuff. Subjects were instructed to endure pain for 15 minutes (goal specification) or were told to simply last as long as possible.

Results indicated that subjects given instructions to endure 15 minutes (a very high standard) lasted much longer than subjects who were given open-ended instructions. Results also showed that subjects who were told to last 15 minutes had lower absolute pain ratings (and in fact reported lower pain ratings on every trial) than subjects given nonspecific goals. The similarity in Thorn and Williams (1974) findings and the results for this experiment suggest that both goal specification and social modeling may set performance standards which in turn affect perceptions of pain.

Change in Heart Rate

With the exception of two subjects in the intolerant condition who showed negative heart rate slopes, all subjects' heart rates increase over time while performing the isometric-sitting exercise. Excluding these two cases, the intolerant subjects showed the greatest increase in heart rate over time.

According to the path analysis, however, heart rates had a direct effect on change in pain for tolerant subjects only. The higher the slope for heart rate (indicating the rise in heart rate over time) the greater the change in pain rating (corresponding to amount of pain experienced while performing the exercise). Tolerant subjects showed less change in heart rate over time and this translated to less change in pain ratings for these subjects.

In addition, change in heart rate indirectly affects endurance through change in pain ratings for the tolerant subjects only. Subjects exposed to tolerant models show less change in heart rate which translates to less change in pain resulting in higher endurance for isometric-sitting.

Bem's (1967) theory of self-perception claims that inference of pain is based on behavior and arousal. Heart rate is one form of physiological arousal from which the perception of pain may be inferred. Results of this study support self-perception theory in that change in heart rate positively affected change in pain rating.

Grimm and Kanfer (1976) investigated the effects of cognitive training in relaxation, verbal/symbolic activities and expectancies of decreased discomfort on heart rate, endurance and pain ratings in subjects exposed to two trials of cold pressor pain. In contrast to the present study, Grimm and Kanfer (1976) found no relation between heart rate and self-reported pain. In accord with this study, however, which indicated no direct relation between change in heart rate and endurance for isometric sitting, however, the results of Grimm and Kanfer's study showed no relation between heart rate and cold pressor endurance. In general, previous research has measured heart rates as correlates of pain threshold or indicators of stress (Cabanac & Leblanc, 1983; Craig & Neidermayer, 1974; Johnson & Cabanac, 1983) but these studies do not utilize heart rates as a major variable in the pain perception process.

Self Efficacy

The results for this study show that social modeling affected self-efficacy scores. Bandura (1977a; 1977b; 1977c; 1977d) claims that self-efficacy perceptions govern and predict behavioral change. Self-efficacy expectations influence an individual's belief in his or her ability to perform a task as well as their persistence and final level of performance. Cognitive research by Bandura (1986) has indicated that the powerful effects of social modeling operate through self-efficacy to affect behavior.

Our pain research shows some support for this view in the results pertaining to the intolerant modeling condition. Subjects exposed to an intolerant model had lower self-efficacy scores and gave in to the pain quickly in comparision to subjects in the tolerant and control conditions. In other words, subjects in the intolerant condition did not believe they could last as long, were not as confident in their ability, and did not endure isometric-sitting as long as subjects in the control and tolerant groups.

Efficacy Congruence

The results also indicate high congruence between expected and actual endurance for subjects in the intolerant condition. At the 100% confidence interval, all subjects in the intolerant condition, met or exceeded their stated endurance level. These subjects set very low performance standards and underestimate their ability to endure isometric-sitting after viewing confederate subjects give in to pain. Results for expected performance show very conservative estimates for intolerant subjects at each level of confidence. At the last indicated interval, for example, intolerant subjects believed they would endure for approximately two minutes, while controls and tolerant subjects more than doubled this estimate by stating four and a half minutes.

In the intolerant condition, self-efficacy appears to play a mediating role in the effect of modeling on endurance. In accord with Bandura's (1977a) self-efficacy theory, subjects exposed to intolerant models in this study report low self-efficacy scores and these scores correlate with actual endurance times. Many studies have demonstrated how cognitive coping strategies (such as modeling) can be used to alter self-efficacy expectations which in turn correlate with performance measures (Bandura, O'Leary, Taylor, Gauthier & Gossard, 1987; Dolce, Doleys, Raczynski, Lossie, Poole, & Smith, 1986a; Litt, 1988; Schiaffino & Revenson, 1992).

The results of our path analysis using multiple regression equations, however, fail to support the role of self-efficacy in the endurance of pain. Self-efficacy is affected by the intolerant modeling condition, but there is no indirect or direct effect of self-efficacy on endurance. Moreover, self-efficacy correlates with all of the variables (modeling, pain threshold, change in pain rating, change in heart rate and endurance), but has no direct or indirect effect on any of them.

This study is not the first to call into question Bandura's model of self-efficacy. Feltz (1982) used path analysis techniques to investigate Bandura's model of self-efficacy in a study that examined approach/avoidance behavior in 80 college students attempting back dives. Bandura's model of self-efficacy predicted that a reciprocal relationship between self-efficacy and diving performance existed and that self-efficacy was the mediator of back-diving performance.

The results of Feltz's (1982) study provide little support for Bandura's model of self-efficacy. Self-efficacy was not the only significant predictor of performance. Diving performance was also predicted by each immediate previous diving performance or by past performance accomplishments. Although the results showed a relationship between self-efficacy and performance, this relation was not equally reciprocal. Performance had a greater effect on self-efficacy than efficacy had on performance for back diving.

A replication of the study (Feltz & Mugno, 1983) included autonomic perception in the Bandura's path model along with self-efficacy, physiological arousal, previous diving performance and actual performance measures. The results indicated that both self-efficacy and physiological arousal (heart rate) significantly predicted performance. The fact that performance on a previous trial, not self-efficacy, was the major predictor of performance on the subsequent trial in both studies downplays the impact of self-efficacy as a mediating variable between diving performances. Although the results for autonomic arousal work indirectly through self-efficacy to affect endurance and thus lend some support to Bandura's theory, the authors contend that subsequent decomposition of the correlations indicated a substantially decreased self-efficacy effect (Feltz & Mugno, 1983).

It is important to note that contrary to the results indicated by our study, heart rates in the study conducted by Feltz and Mugno (1983) did affect performance through self-efficacy, even though the authors report that the influence of self-efficacy decreased after trial one. In addition, our study showed that self-efficacy had no effect on isometric performance while Feltz (1982) and Feltz & Mugno (1983) report a reciprocal relation between self-efficacy and diving performance.

SUMMARY

The purpose of this study was to investigate the effects of social modeling and monetary reinforcement on endurance of a painful exercise. In addition, the present experiment aimed to clarify variables that mediate these effects. The findings indicate that social modeling is a powerful determinant of pain endurance. As expected, exposure to pain-enduring models resulted in high levels of endurance, while exposure to models who gave in to the pain produced low endurance levels for isometric-sitting.

Contrary to previous research, self-efficacy ratings did not affect endurance of a painful task or any other variable employed in this study. Bandura (1986) claimed that the relationship between self-efficacy and behavior could be quantified by computing the correlation between self-efficacy and performance as well as the degree of congruence between self-efficacy and performance using a cutoff strength value.

This study utilized both methods and found that subjects exposed to intolerant models report low self-efficacy ratings. Self-efficacy, in turn, correlates with endurance of a painful exercise. In addition, results for the congruence measures suggest that subjects exposed to intolerant models underestimate their ability to endure a painful exercise. Further analysis, however, that decomposed all the correlations into direct and indirect effects using multiple regression techniques clearly indicated that self-efficacy had no effect on endurance or any other variable employed in this study.

Importantly, the results of the path analysis illustrate the necessity of going beyond simple correlational and congruence measures to determine the existence of causal relations between variables. Without path analysis, the correlational and congruence measures used in this experiment would erroneously support Bandura's self-efficacy theory that suggests the effects of modeling operate through self-efficacy expectancies to affect pain behavior.

This experiment is the first to show indirect effects of social modeling on endurance through pain threshold and change in pain ratings. In addition, this study is the first to show that the indirect effects of modeling on endurance through these mediating variables differ according to modeling condition. Subjects exposed to intolerant models report low pain thresholds, which in turn, result in poor performance times for isometric-sitting.

Social modeling indirectly affects endurance for subjects exposed to tolerant models, as well, but this process differs from the intolerant model condition. Exposure to a tolerant model produces less change in pain ratings. Pain ratings increase over time for all subjects, but the slower rate of change results in higher endurance for subjects in the tolerant condition only.

Rate of payment in this study did not affect endurance. There was an interaction effect of modeling and monetary reinforcement on endurance for the ***reduced sample*** of tolerant subjects. These subjects, who were motivated by the high performance standard set by the models, endured isometric-sitting longer when money was contingent on the exercise. The quadratic relation between money and endurance suggests that the discomfort of pain ultimately overrides the effects of money.

Based on the findings of this study, additional experiments that separate the temporal measures of self-efficacy and pain perception are needed to further clarify the indirect effects of social modeling on pain endurance. In addition, analyses that move beyond simple correlational and congruence measures of self-efficacy to more sophisticated statistical procedures such as those based on multiple regression and structural equation modeling (Duncan, 1975; Goldberger & Duncan, 1973; Finney, 1972; Hayduk & Wonnacott, 1981) are needed to clarify these effects. Generally, this study supports the important role of social modeling influences on pain perception and endurance. This experiment does not support a mediating role of self-efficacy expectancies on endurance of pain.

Table 1
Congruence between self-efficacy expectations and actual endurance

	100% Confidence Level	50% Confidence Level	Lowest Confidence Level (excluding zero)
Intolerant Model Condition	100%	93.3%	83.3%
Control (No Model) Condition	93.3%	69.0%	43.3%
Tolerant Model Condition	96.7	79.3%	56.7%

Table 2
Expected endurance (in seconds) by confidence level and modeling condition

	100% Confidence Level	50% Confidence Level	Lowest Confidence Level (excluding zero)
Intolerant Model Condition	34.5	93.5	123.0
Control (No Model) Condition	73.0	186.5	256.5
Tolerant Model Condition	90.2	186.0	256.5

Table 3
Pearson correlation matrix for all the variables employed in this study

	Pain Threshold	Endurance (minutes)	Change in Heart Rate	Change in Pain	Self-Efficacy	Intolerant Model	Tolerant Model
Pain Threshold	1.00 p=	0.38 p=.00	-0.19 p=.04	-0.11 p=.15	0.30 p=.002	-0.43 p=.00	0.24 p=.01
Endurance (minutes)	0.38 p=.00	1.00 p=	-0.37 p=.00	-0.82 p=.00	0.30 p=.002	-0.35 p=.00	0.46 p=.00
Change in Heart Rate	-0.19 p=.04	-0.37 p=.00	1.00 p=	0.41 p=.00	-0.09 p=n.s	0.27 p=.005	-0.18 p=.05
Change in Pain	-0.11 p=n.s	-0.82 p=.00	0.41 p=.00	1.00 p=	-0.17 p=.05	0.21 p=.03	-0.33 p=.001
Self-Efficacy	0.30 p=.002	0.30 p=.002	-0.09 p=n.s	-0.17 p=.05	1.00 p=	-0.54 p=.00	0.30 p=.002
Intolerant Model	-0.43 p=.00	-0.35 p=.00	0.27 p=.005	0.21 p=.03	-0.54 p=.00	1.00 p=	-.50 p=.00
Tolerant Model	0.24 p=.01	0.46 p=.00	-0.18 p=.05	-0.33 p=.001	0.30 p=.002	-0.50 p=.00	1.00 p=

Table 4
Decomposition of bivariate covariations into direct, indirect, total and noncausal effects

		Causal			
Bivariate Relationship	Total Covariance (A)	Direct (B)	Indirect (C)	Total (D) B + C	Noncausal (E) A - D
Self-Efficacy & Endurance	.3045 p=.002	None	None	None	.3045
Pain Threshold & Endurance	.3819 p=.000	.2542	None	.2542	.1277
Heart Rate & Endurance	-.3741 p=.000	None	.3002	.3002	.0739
Change in Pain & Endurance	-.8165 p=.000	-.7316	None	-.7316	-.0849
Intolerant Model & Endurance	-.3509 p=.000	None	-.0942	-.0942	-.2567
Tolerant Model & Endurance	.4605 p=.000	.1513	.2175	.3688	.0917
Intolerant Model & Self-Efficacy	-.5414 p=.000	-.5199	None	-.5199	-.0215
Tolerant Model & Self-Efficacy	.3049 p=.002	None	None	None	.3049
Intolerant & Pain Threshold	-.4332 p=.000	-.3706	None	-.3706	-.0626
Tolerant & Pain Threshold	.2360 p=.013	None	None	None	.2360

Intolerant Model & Heart Rate	.2710 p=.005	None	None	None	.2710
Tolerant Model & Heart Rate	-.1779 p=.005	None	None	None	-.1779
Intolerant & Change in Pain	.2068 p=.027	None	None	None	.2068
Tolerant & Change in Pain	-.3285 p=.001	-.2973	None	-.2973	-.0312
Pain Threshold & Heart Rate	-.1869 p=.041	None	None	None	-.1869
Pain Threshold & Pain Change	-.1115 p=n.s	None	None	None	n.s
Self-Efficacy & Pain Threshold	.3041 p=.002	None	None	None	.3041
Self-Efficacy & Heart Rate	-.0855 p=n.s	None	None	None	n.s
Self-Efficacy & Change in Pain	-.1721 p=.054	None	None	None	-.1721
Heart Rate & Change in Pain	.4103 p=.000	.3787	None	.3787	.0316

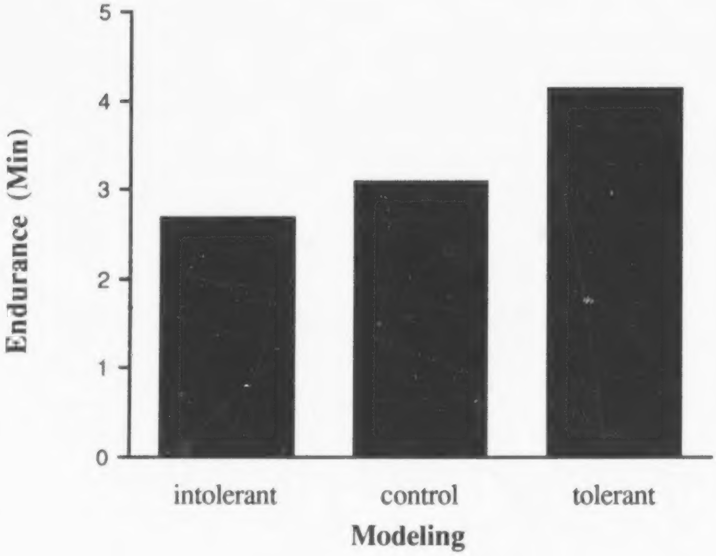


Figure 1.
Effects of social modeling on endurance of pain

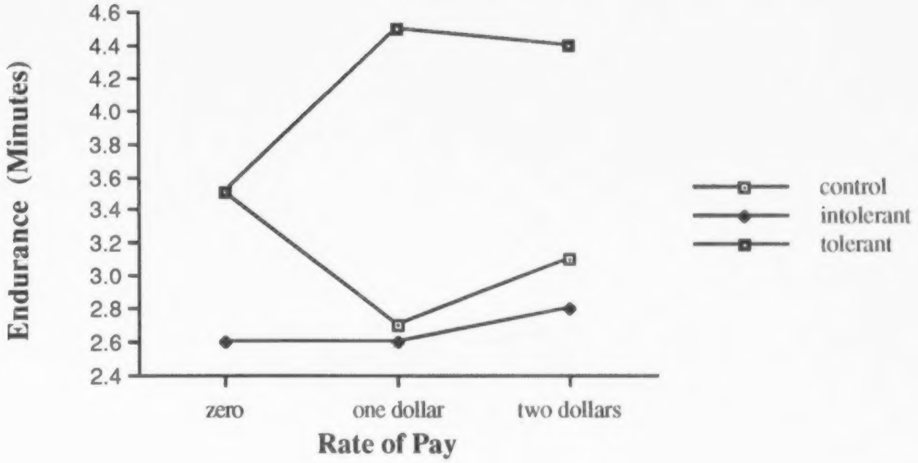


Figure 2.
Interaction effect of modeling and rate of pay on endurance for the reduced sample

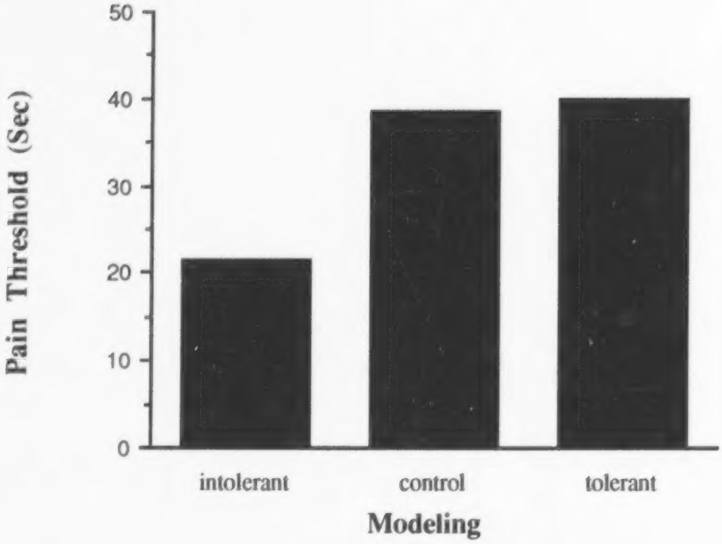


Figure 3.
Effects of social modeling on pain threshold

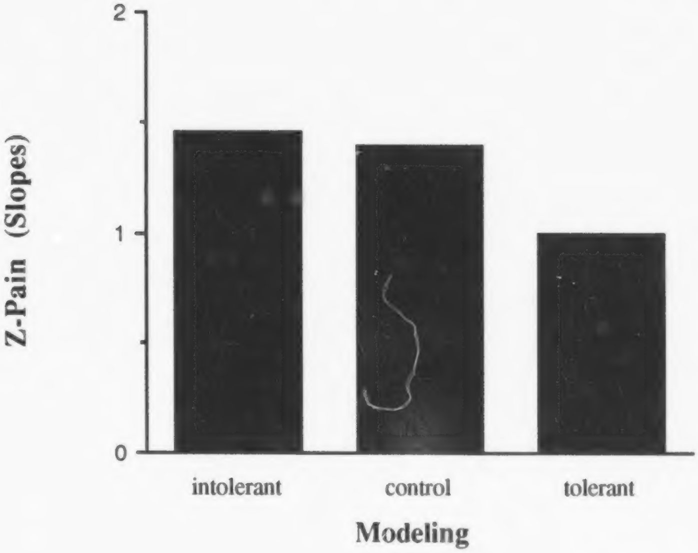


Figure 4.
Effects of social modeling on rate of change in pain

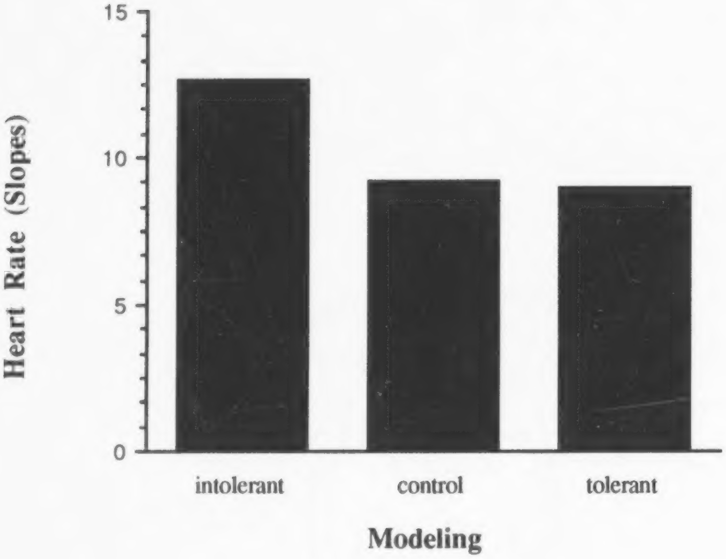


Figure 5.
Effects of social modeling on rate of change in heart rate

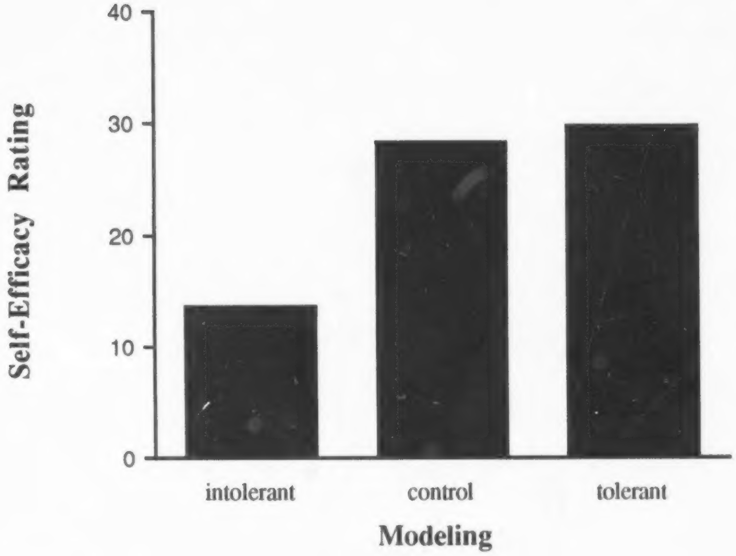


Figure 6.
Effects of social modeling on self-efficacy ratings

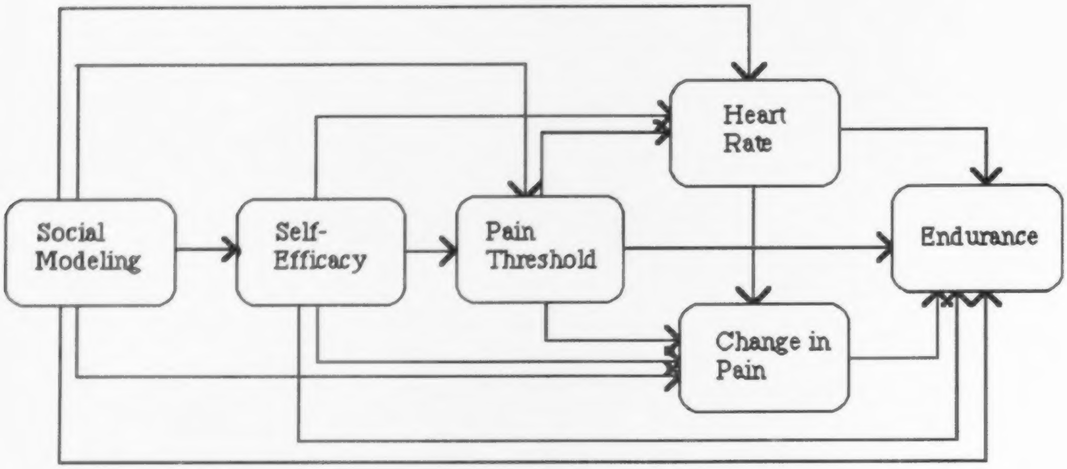

Social Modeling
Self-Efficacy
Pain Threshold
Heart Rate
Endurance
Change in Pain

Figure 7.
Theoretical model depicting the causal order and direction of effects for the variables employed in this study

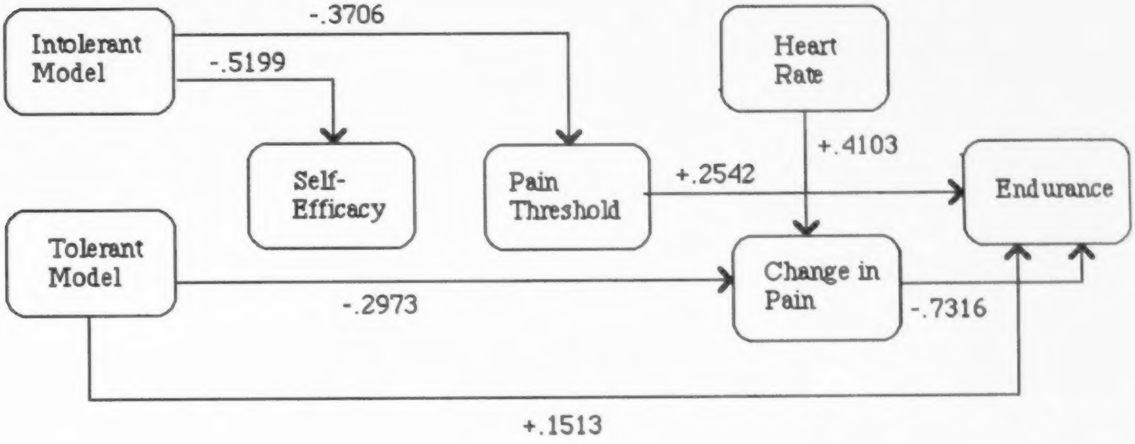
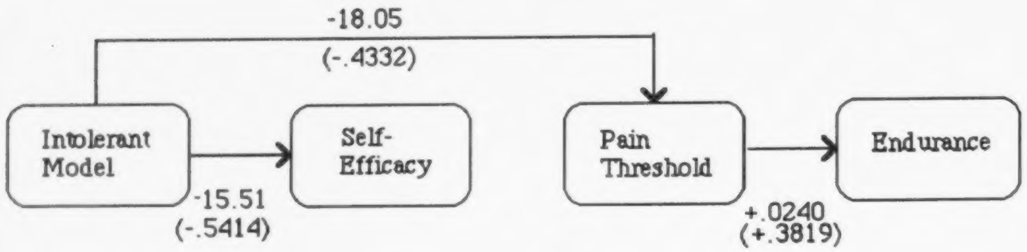

Intolerant Model
-.3706
-.5199
Heart Rate
Self-Efficacy
Pain Threshold
+.4103
+.2542
Endurance
Tolerant Model
Change in Pain
-.2973
-.7316
+.1513

Figure 8.
Path model of the indirect and direct effects of the predictor variables on endurance using standardized regression coefficients

Intolerant Model Condition


-18.05
(-.4332)
Intolerant Model
Self-Efficacy
Pain Threshold
Endurance
-15.51
(-.5414)
+.0240
(+.3819)

Tolerant Model Condition

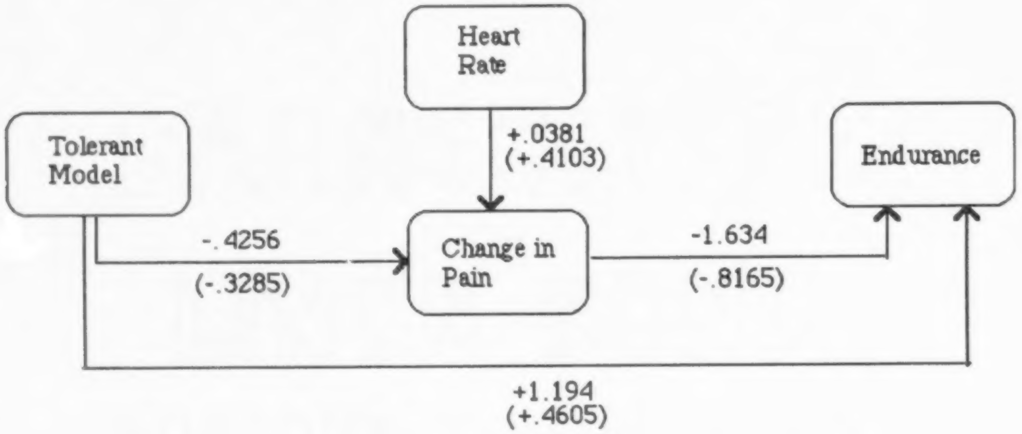

Heart Rate
+.0381
(+.4103)
Tolerant Model
Endurance
-.4256
(-.3285)
Change in Pain
-1.634
(-.8165)
+1.194
(+.4605)

Figure 9
Refined path models indicating how intolerant and tolerant models affect endurance using unstandardized and standardized regression coefficients

Note. Standardized regression coefficients are shown in parentheses. Only significant coefficients are depicted in the models; all other hypothesized relationships were found to be nonsignificant.

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LITERATURE REVIEW

Self-Efficacy Theory

Bandura's (1977a; 1977b; 1977c; 1977d) self-efficacy theory provides a framework that attempts to explain how individual expectations govern and predict behavioral change. Competent performance of a task such as learning to ride a bicycle, for example, naturally involves skills necessary to balance and maintain control of the bike. In addition to the physical requirements, a degree of confidence in one's ability to learn to ride the bike is an important element for determining how the skills are utilized. Bandura (1986) refers to this self-judgment of ability as perceived self-efficacy. Perceived self-efficacy does not refer to the skills needed to perform a task, but rather to one's judgment of what he or she can do with these skills (Bandura, 1986).

Self-efficacy expectations include an individual's belief in his or her ability to perform a task as well as their persistence and final level of performance. Interestingly, possessing the necessary skill or ability to complete a task does not guarantee that an individual will use it. A student may, for example, have the intelligence but lack the initiative to study and obtain high grades on his or her final exams. In addition, many factors enhance or diminish one's ability to perform a task. Depending upon circumstances such as hours spent studying and sleeping, the same student may perform remarkably well on one exam and poorly on another.

In terms of ability to complete a task, two individuals with identical skills may react differently when faced with the same exercise. Two children with comparable physical skills but very different perceptions of self-efficacy, for example, are presented with bicycles for the first time. The child with high self-efficacy has more confidence in his ability to ride a bike and will probably attempt to ride his bike sooner than the child with low confidence.

In addition to confidence in one's ability, perceived self-efficacy determines persistence and final level of performance for a task. A child with high self-efficacy will not be easily discouraged if he falls off his bike while he is attempting to master this skill. In a short period of time, this boy will be successfully riding his bike throughout the neighborhood. The other child may never want to get back on the bike after encountering the very first obstacle. Self-efficacy, then involves perception of one's ability to perform a task as well as persistence and final level of performance for that task (Bandura, 1986)

Collins (1982) examined the effects of perceived self-efficacy on ability to solve difficult mathematical problems in children of either high or low mathematical ability. The study found that ability affected performance at each of the two levels and self-efficacy had a significant effect on performance independent of underlying mathematical ability. Children who perceived themselves to be of high mathematical self-efficacy, for example, solved more problems, were less likely to persist with inadequate strategies and reworked incorrect problems to perfection. As this study clearly illustrates, self-efficacy has powerful effects on performance that operate independently of underlying skill or ability.

Forming Perceptions of Self-Efficacy

According to Bandura's self-efficacy theory, perceptions of self-efficacy are based on four sources of information: enactive attainment, vicarious experience, verbal persuasion and physiological state (Bandura, 1986). The strongest source of information for self efficacy is enactive attainment (Bandura, Adams and Beyer, 1977). Enactive attainment refers to self-efficacy based on past experiences with success. Repeated successful experiences provide a framework from which positive self-efficacy perceptions are produced. If an individual fails an initial attempt to complete a puzzle for example, he will not be discouraged if he has completed many similar puzzles in the past. In other words, the past experiences with success have been generalized to future expectations of success in these situations.

Another source of information on which self-efficacy is based is called vicarious experience. Vicarious experience is particularly useful for the formation of self-efficacy beliefs when enactive experience cannot be utilized as a source of information (Bandura, Adams, Hardy & Howells, 1980). By visualizing or observing others reach a goal, self-efficacy perceptions are increased such that an individual persuades himself that he also possesses the skill(s) necessary to complete the task in question.

In addition to vicarious experience, verbal persuasion and physiological state can also influence a person's belief in his or her ability to master a task. Verbal persuasion includes prompts that provide encouragement and heighten performance expectations. Within realistic bounds, prompts such as "oh, you just about did it," or "you'll be able to ride without help in a few more tries" can heighten a child's self-efficacy and contribute to successful bike riding.

People may even rely on information from their physiological state when assessing ability to perform a task. A person attempting to sky dive for the first time after hours of training may infer from his sweating palms and acceleration in heart rate that he is experiencing a great deal of fear. This type of arousal may decrease perceived efficacy and self-doubt may prevent him from trying out this newly acquired skill. In addition, fatique or pain sensations may be used as indicators of physical inefficacy when performance is based on strength and stamina (Bandura, 1986; pp.400-401).

Modeling, Self-Efficacy and Behavior

According to Bandura (1977), the relationship between self-efficacy and behavior change can be measured in three ways. Correlations between self-efficacy ratings and performance levels can be computed. Secondly, degree of congruence can be calculated for aggregate scores for self-efficacy and performance using a set point strength for self-efficacy and then computing the correspondence with actual performance. Finally, a more refined congruence can be obtained by calculating the probability of performance as a function of self-efficacy ratings (Bandura, 1986).

To test the relationship between self-efficacy and behavior, Bandura et al (1980) examined avoidance behavior, fear arousal and self-efficacy in subjects who had severe snake phobias. The test of avoidance behavior consisted of a graded series of 29 tasks involving a boa constrictor. The tasks included stages that involved approaching the caged snake, looking down on the snake, touching and then holding the snake and finally tolerating the snake moving about freely in the subjects' laps while keeping their hands passively at their sides. The behavior avoidance score was the number of tasks (out of 29) the subject could perform.

Self-efficacy ratings were measured after the test of behavior avoidance to ensure that subjects understood the required tasks. Subjects were instructed to judge the number of tasks they would perform, rate the strength of their efficacy on a 100-point scale (in 10-unit intervals) ranging from high uncertainty to complete certitude. Efficacy measures included magnitude (or level), strength and generality. Level of self-efficacy was the number of tasks subjects expected to perform with a value above 10. Strength was computed as the sum of magnitude scores across the tasks and dividing by the total number of performance tasks.

All subjects underwent a period of training in which they were instructed to imagine others performing the treatment tasks with initial apprehension but eventual mastery. Participants described the visualized scenes and were prompted to provide specific details. Following this training subjects were asked to visualize four model conditions. In the first condition, subjects were asked to imagine a same-sex model of similar age to themselves performing the tasks. The second condition called for a visualization of an older opposite-sexed model. The third condition was an older same-sexed model and the final condition was an opposite-sexed model of comparable age. All subjects were exposed to these four conditions and this treatment was referred to as cognitive modeling.

The results showed significant improvements on all behavioral and fear-reduction measures for individuals who received instructions to imagine models (cognitive modeling) and who rated their self-efficacy following the visualization, in comparsion with those who did not rate self-efficacy. Cognitive modeling enhanced level and strength of self-efficacy toward threats as well as approach behavior to threatening tasks. Modeling also increased coping efficacy which was associated with a reduction in fear arousal. Congruence between self-efficacy and actual performance was reported to be as high as 81%. In general, findings indicate that cognitive modeling increased phobic's self-efficacy ratings and these ratings predicted overall task performance.

To test the generality of self-efficacy theory over behavioral domains, Bandura et al (1980) replicated the previous study on agoraphobics. Agoraphobia is a clinical term used that refers to a fear of public places. Severe agoraphobics tend to isolate themselves within the boundaries of their homes. Common activities such as work or shopping arouse fear of crowds and elevators that produce feelings of entrapment that generally prevent these individuals from entering public places.

Agoraphobic subjects reported their perceived efficacy and phobic behavior prior to treatment. Self-efficacy scales included a hierarchy of common activities such as eating in a restaurant and riding in an elevator that increasingly produce fear in these subjects. In contrast to the previous experiment, subjects received training in coping techniques and were asked to perform feared tasks rather than simply receive instructions to visualize models performing the tasks. The authors do not explain the coping treatment but state that subjects attended group sessions that provided training in self-relaxation, proximal goal setting as well as training in assertiveness and self-expressive behavior conducted by seven field therapists.

Coping behavior was measured before and after treatment involved. Subjects rated the intensity of fear they experienced when each performance task was described to them (pre-treatment) and while performing the task (post-treatment). Subjects were asked to perform a series of tasks in situations that were fearful to them. Tasks ranged from slightly fearful (walking alone a few steps beyond the door of the treatment center) to highly fearly (completing a half-mile course through busy areas of the city). Clients were asked to perform each of the coping tasks in a specified sequence according to a success criterion.

In accord with the preliminary study, the results indicate that level and strength of self-efficacy were increased by cognitive strategies (in this case, training in coping techniques). Improvements in coping behaviors correlated with level of efficacy change and the correspondence between self-efficacy and performance at the end of treatment was 80%. The correlational and congruence measures support Bandura's (1980) claim that self-efficacy mediates changes in fear arousal and behavior. In addition, these studies indicate that perceived self-efficacy ratings can be enhanced by cognitive strategies such as imagining others perform fearful tasks (cognitive modeling) or learning to cope (through various techniques such as relaxation).

Cognitive Coping Strategies and Pain

The effectiveness of cognitive-based strategies for behavioral change has resulted in substantial research focused on the cognitive control of pain (Avia & Kanfer, 1980; Berntzen, 1987; Dworkin, Chen, Schubert, & Clark, 1984; Gauron & Bowers, 1986; Grimm & Kanfer, 1976; Keefe, Caldwell, Williams, Gil, Mitchell, Robertson, Martinez, Nunley, Beckham, Crisson & Helms, 1990; Lacroix & Barbaree, 1992; Thorn & Williams, 1989). Cognitive treatment of pain is based on psychological theory that distinguishes between two components of internal pain commonly labelled "psychological" and "sensory" (Rachlin, 1985).

Sensory pain can be traced to a stimulus that produces it and is no longer felt when that stimulus is removed--as occurs when you place your hand in extremely hot dish water and then quickly pull it out. Psychological or psychogenic pain cannot be attributed to a specific stimulus or body problem and is often described in terms of mind. This includes emotional and personality-based perceptions of pain (Fordyce, 1976).

The intensity of psychological pain is affected by an infinite number of sources such as attitude, or the context in which the pain occurs (Melzack & Wall, 1965). An individual may, for example, feel a great deal of pain while exercising beyond his normal capacity but not report a high intensity due to enjoyment for the activity. While another person may report high levels of pain after only a few seconds of exercise.

Pain Perception

It is important to note that pain perception is a very subjective and highly individualistic phenomenon. In some cases, the pain-evoking stimulus may be present but not at a threshold the individual can detect. In addition, a person may perceive pain in the absense of any pain-producing stimulus. Many factors such as learning can influence an individual's perception of, reaction to and tolerance for pain. Pain expressions such as grimacing and crying are conditioned responses that serve as discriminative stimuli for reactions from others (Skinner, 1969). A crying child will often get attention, sympathy and support in general from observers. This supportive behavior, in turn, reinforces the use of tears and pain behaviors because it increases the probability of future pain expressions.

According to Bandler, Mandaras, and Bem (1968) pain perception is influenced by three sources of information. The first source of information provides justification for enduring the painful stimulation. A competitive runner will, for example, endure a great deal of pain in order to win a race that will qualify him for a national meet. Upon finishing, the athlete may even report that he perceived little or no pain during the run because qualifying justified the extra effort and hence, more pain.

Another source of information for the perception of pain comes from situational cues. Situational cues include an awareness of physiological states such as sweating and an increase in heart rate which often accompany a painful exercise. Dworkin et al (1984) examined the effects of high and low information clarifying the physiological effects of an analgesic/sedative drug (nitrous oxide) on pain threshold and tolerance using a tooth pulp shock.

Teeth and gums are particularly sensitive to painful stimuli. A tooth shock procedure involves the deliverance of a painful shock to a subject's tooth (usually an incisor) through a hand-held instrument that resembles a dentist drill. Nitrous oxide is a pain-relieving drug commonly used in the course of dental treatment. Subjects in this study were given high or low levels of information regarding the effects of nitrous oxide. Subjects were either given a brief description explaining that the drug produced a tingling sensation and helped make dental treatment more comfortable (low information) or a very detailed and lengthy discription outlining the drugs' history, uses, and physiological effects (high information). Subjects then breathed nitrous oxide through a nose mask while receiving tooth pulp shocks.

Results indicated higher sensation thresholds, pain thresholds and tolerance of pain for subjects in the high information treatment. In other words, detailed information prior to experiencing a painful stimulus results in less reported pain and greater endurance for that stimulus.

The third source of information that influences individual perceptions of pain is overt behavior. Studies of self-perception by Bem (1965, 1966, 1967) demonstrated how an individual uses his or her behavior as a base from which perceptions of painful stimuli are assessed. If an individual completes a painful task, for example, he may reflect on his sucessful behavior and think he must not have found the experience too painful. Similarly, if a person does not complete a painful task, he may rate his perceived level of pain as very high. In this sense, the ability to tolerate pain affects our judgment of the intensity of pain rather than pain perception influencing tolerance.

Acute and Chronic Pain

Principles of learning and social influence have been applied to pain control in an effort to reduce suffering in individuals who suffer from acute and chronic pain. Acute pain refers to present exposure to a painful stimulus of a relatively short duration. Headaches and muscle spasms are common types of acute pains. Chronic pain involves exposure to a painful stimulus over a period of several months and even years (Weinsenberg, 1977). Examples of chronic pain include back aches and arthrithis in various bodily joints and limbs.

Several studies have examined behavioral and affective responses to acute and chronic pain in an effort to identify and assess typical pain behavior (Arntz & Lousberg, 1990; Jahanshahi & Philips, 1986; Lacroix & Barbaree, 1992; Perkins, Grobe, Jennings, Epstein & Elash, 1992; Romano, Syrjala, Levy, Turner, Evans & Keefe, 1988; Tursky, Jamner & Friedman, 1982). In addition, several pain scales, questionnaires and assessment tools have been developed to diagnose acute and chronic types of pain as well as individual pain thresholds (Crockett, Prkachin, Craig & Greenstein, 1986; Jones, 1979; Melzack, 1975; Meyers, Bourgeois, Stewart & LeUnes, 1992; Perkins, Groebe, Jennings, Epstein & Elash, 1992; Tursky, Jamner, & Friedman, 1982;). Recent studies have also examined other factors such as fear-evoking situations which can lead to over and underprediction of pain (Arntz & Lousberg, 1990; Rachman & Arntz, 1991).

Cognitive Control of Pain

Common cognitive strategies used to influence pain behavior include pain coping skills or self-management techniques that compete with reactions to pain and thus increase tolerance to painful stimuli (Kanfer, 1975; Kanfer & Seidner, 1973). Coping skills can include the use of pleasant imagery, relaxation and distraction techniques, verbal and symbolic training, as well as, cognitive restructuring. The use of multiple cognitive coping strategies has proven effective in increasing tolerance to aversive stimuli and reducing reports of pain, physical disability and discomfort in athletes, individuals suffering from chronic arthritis and subjects performing painful tasks using the cold-pressor test and an ischemic pain test, (Avia & Kanfer, 1980; Berntzen, 1987; Gauron & Bowers, 1986; Grimm & Kanfer, 1976; Keefe, Caldwell, Williams, Gil, Mitchell, Robertson, Martinez, Nunley, Beckham, Crisson & Helms, 1990; Thorn & Williams, 1989).

Social Modeling and the Self-Perception of Pain

Social modeling is another cognitive strategy that influences pain perception and tolerance. Previous research on social modeling indicates that people are influenced by others' verbal and nonverbal reactions to pain. Nonverbal indicators of pain include facial expressions such as clenched teeth, grimacing, brow-lowering and blinking. Other painful expressions include things like clenching your finger to make a fist, rubbing or bracing. Nonverbal expressions provide observers with information from which internal states such as pain are inferred (Prkachin & Craig, 1985). Some researchers claim that nonverbal expressions are better indicators of pain than verbal reports because facial expressions are more difficult to distort and may be less prone to bias (Ekman & Friesen, 1969; Ekman & Friesen, 1974).

Previous investigations (Patrick, Craig & Prkachin, 1986; Prkachin & Craig, 1985) examined the impact of nonverbal expressions of pain and their responsiveness to social modeling on observers judgment of acute pain. Prkachin and Craig (1985) videotaped subjects while they rated high, medium and low levels of shock. Simultaneously, these subjects were exposed to either a tolerant social model (who pretended to receive the same shock but rated the shock as 25% lower than the subject's rating) or an intolerant model (who rated the shock as 25% more painful). A second group of volunteers then observed the videotapes and judged the level of shock delivered on the basis of facial cues (grimaces, eye brown lowering, etc.).

The results showed that change in facial expression to the shocks was directly related to stimulus intensity, self-report of pain and observers' judgments of subjects' distress. The authors suggest that nonverbal behavior provides a valid index of pain that can be utilized as a dependent variable in pain research. In terms of social modeling, exposure to a tolerant model increased pain thresholds and tolerance for shocks. In addition, exposure to tolerant models decreased pain ratings for high intensity shocks and reduced pain-related facial cues. Social modeling, then, influences overt behaviors (in this case facial expressions) that observers interpret as indicators of pain.

Patrick and his associates (1986) also investigated the effects of pain-related facial expressions in conjunction with social modeling on observers judgments of pain. Subjects were videotaped and reported their discomfort to electric shocks after exposure to one of three social modeling conditions. The pain stimulus consisted of an ascending series of shocks beginning at undetectable levels. Subjects were instructed to push a button marked painful when the first detectable shock was administered (pain threshold) before rating discomfort on a 14-point pain scale. After pain threshold was indicated, subjects were given a random series of 15 shocks, 3 at each of five intensity levels. Social modeling involved exposure to either a tolerant model (who gave pain ratings two descriptors lower than subects on a 14-point scale), an intolerant model (who indicated pain at two descriptors higher) or an inactive companion (control). The videotapes were then coded for facial activity and observers were asked to rate them for discomfort.

Results indicated that subjects exposed to tolerant models had higher thresholds and thus received higher shocks at each level than subjects exposed to intolerant models. All subjects reported increased discomfort with increased shock intensity. Subjects exposed to tolerant models reported pain ratings equivalent to those indicated by subjects in the intolerant condition despite receiving higher shocks at all five intensity levels.

Interestingly, judges attributed the most pain (based on facial expressions) to subjects in the tolerant model condition, less pain to subjects in the control condition and the least pain to subjects exposed to intolerant models. Observers pain ratings for subjects in the tolerant condition exceeded the other conditions at all shock levels excluding the first one. Although subjects in the tolerant condition verbally reported no more discomfort while receiving greater shocks, observers perceived them to be in greater pain than subjects in the intolerant condition. The authors conclude that while social modeling affects pain perception and tolerance, facial expressive behavior may represent a nonvoluntary reaction to noxious stimuli that is unaffected by social influences.

Modeling pain through facial expressions, then, can be a powerful source of information for inferring internal states. Interestingly, however, providing additional information that is pain-relevant, but not contingent on the pain stimulus, can bias observers judgments of pain expressive behavior.

Prkachin et al (1983) examined the impact of pain-relevant biasing information on nonverbal pain judgments. The judges were informed that models were either exposed to a hypersensitivity, analgesic or control (no information) treatment prior to receiving electrical shocks. The results indicated that judges exposed to hypersensitivity information (pain-producing) attributed more pain to the models than observers exposed to the analgesia (pain-relieving) condition independent of the actual shock delivered. This experiment clearly demonstrates how pain estimation can be influenced by beliefs about others' ability to withstand pain even if these beliefs are not based on accurate information.

In addition to the judgment of pain in others, studies have examined the effects of observing others perform painful tasks on subsequent pain behavior of subjects. Many laboratory studies substantiate the effects of vicarious experience on pain tolerance (Bandura, Adams, Hardy & Howells, 1980; Craig, 1986; Craig & Neidermayer, 1974; Craig, Best & Ward, 1975; Thelen & Fry, 1981; Turkat & Guise, 1983; Turkat, Guise & Carter, 1983). Taken together, the findings show that subjects who are exposed to tolerant models will endure electrical shocks, perform tasks while under finger pressure pain, or withstand a cold pressor task longer than subjects who are exposed to an intolerant model.

Self-Efficacy and Pain Behavior

The mechanism by which these cognitive strategies mediate pain reduction and increase pain tolerance is not yet understood. Two prevelant interpretations for the effects of modeling on pain behavior include self-efficacy theory and self-perception theory. One explanation for the effectiveness of cognitive coping skills on pain behavior is provided by self-efficacy expectations. Mastery of coping skills may increase self-efficacy expectations that in turn affect behavior. In addition, observing someone else tolerate a painful task may eliminate initial doubts by increasing self-efficacy expectations such that the observer believes he too can endure the painful task.

Within pain research, self-efficacy scores represent performance expectations that include perceived level of endurance as well as confidence in one's ability to manage and cope with pain. In other words, individuals with high self-efficacy expectations regarding ability to cope with pain will be able to tolerate a painful stimulus for a greater length of time than individuals with low pain-coping efficacy. Many studies have examined the role of self-efficacy on pain tolerance using a cold pressor test. In this procedure, subjects are instructed to immerse their dominant hand in ice water for as long as possible.

Dolce et al (1986 a) examined the role of self-efficacy expectancies in the prediction of pain tolerance using a cold pressor test. Self-efficacy ratings were significantly correlated with pain endurance at each phase of the experiment. Surprisingly, self-efficacy was a better predictor of endurance than pain ratings, which did not correlate with pain tolerance times. Litt (1988) lends some support for the effects of self-efficacy on pain tolerance in two experiments using a cold pressor task. The first experiment was designed to test whether self-efficacy is a causal determinant of pain tolerance and the second experiment examined how perceived control and efficacy interact to affect pain tolerance.

In the first experiment, subjects were assigned to one of five efficacy conditions: high-high, high-low, low-high, low-low or control. All subjects reported self-efficacy ratings regarding their ability to endure the cold-pressor task prior to each of three experimental trials. In accord with Bandura's (1977) suggestions, the 20-item self-efficacy questionnaire assessed both magnitude and strength judgments. Magnitude was calculated by summing the number of time intervals subjects believed they would endure the cold-pressor (out of a total of 20 time intervals). Strength judgments were obtained for each of the 20 items by asking subjects to rate how confident they were at each level on a scale of 0-100.

Following the first cold-pressor trial, subjects were falsely informed that their performance was very good and ranked in the 90th percentile in female undergraduate tolerance times (high-high, high-low conditions), not very good represented by the 37th percentile (low-high, low-low conditions), or were given no feedback (control). Following the second cold pressor trial, subjects were again informed that their performance was either very good (high-high, low-high), not so good (high-low, low-low). Again, controls received no performance feedback. Subjects then completed the final cold-pressor trial.

The results indicated that feedback in general, affected strength and magnitude of self-efficacy in the expected directions. With the exception of the high-low group, self-efficacy ratings for subjects given high performance feedback after trial 1 increased prior to trial 2. Low performance feedback resulted in decreased efficacy prior to trial 2. Similarly, with the exception of the low-low condition, self-efficacy increased in the high conditions and decreased in the low conditions from trial 2 to 3.

Tolerance time-changes from trial 1 to 2 for three of the four experimental conditions did not differ significantly from control group but the results for tolerance time-changes between trial 2 and 3 indicated that tolerance was affected by self-efficacy information. Compared to controls, changes in tolerance times for this period showed decreases for high-low and low-low groups and increases in tolerance for the low-high group. Correlational analyses showed that self-efficacy scores generally predicted tolerance times for each subsequent trial.

The second cold-pressor experiment examined the relationship between perceptions of self-efficacy and control. Litt (1988) hypothesized that perceptions of control over a painful stimulus could increase tolerance for pain in subjects who possess high efficacy regarding their ability to use that control. Subjects who show high confidence in their abiliby to utilize control over a painful stimulus should endure the cold-pressor for longer than subjects who have little confidence in their ability to alleviate pain.

The self-efficacy instrument used to measure expected endurance for the cold-pressor test was identical to experiment 1. To establish the credibility of a measure for perceived control over cold-pressor pain, subjects were given a four-item Likert scale that assessed opinions regarding the usefulness of hand-temperature biofeedback training to cope with cold-pressor pain. A ten-item self-efficacy instrument for hand-warming assessed subjects confidence in their ability to raise their hand temperature. Based on time intervals, subjects estimated how long it would take them to raise their hand temperature and maintain it. In addition, the form assessed subjects' confidence (on a scale of 0-100) for achieving the requisite performance.

Subjects were given false feedback for hand-warming by an audio signal that sounded when hand-warming supposedly occurred. Subjects were either assigned to a high self-efficacy condition (and heard the tone sound an average of 8 times every 10 seconds) or a low self-efficacy condition (and heard the audio tone twice every 10 seconds). Half of the subjects in high and low efficacy conditons were assigned to a high-perceived control or a low-control condition. Prior to the cold-pressor test, subjects were asked to indicate their preference for control based on either escape contingent on hand-warming performance or no control (escape following an unknown time limit set by the experimenter). Subjects were informed that the condition they would actually be assigned to would depend, not on their preference, but by a toss of a coin.

Results for the check on credibility of hand-warming indicated that subjects believed that hand-warming could be manipulated subjectively and that it would help reduce cold-pressor induced pain. Subjects with high efficacy ratings for perceived control of hand-warming were more likely to opt for personal instrumental control than those with low self-efficacy for hand-warming. The results showed that subjects with high degrees of efficacy or control endured the cold-pressor pain longer than subjects with low efficacy. Subjects who perceived personal control over the painful stimulus (through false feedback showing high rates of hand-warming) and had high efficacy regarding their ability to use this control endured the cold-pressor induced pain the longest.

Litt (1988) claims that these findings of these two studies support the contention that self-efficacy expectations are determinants, not simply correlates of performance. In addition, self-efficacy expectations appear to mediate the desirability of providing control.

Bandura (1987) tested the effects of perceived self-efficacy on opiod and nonopiod mechanisms of pain control using the cold pressor test. Subjects in this study were trained in cognitive coping techniques, received a placebo or received no intervention (control). Findings support the mounting evidence that high self-efficacy scores are correlated with increases in pain tolerance. Training in cognitive coping strategies enhanced self-efficacy beliefs to withstand and reduce pain on the cold-pressor task. Placebo medication increased self-efficacy to withstand the pain but did not affect beliefs about reducing pain. Control subjects did not change self-efficacy expectations regarding tolerance or pain reduction. In addition, regardless of the experimental condition, the higher the self-efficacy for pain tolerance the longer they endured the cold pressor test.

Self-Perception and Pain Behavior

In addition to self-efficacy theory, another explanation for the effectiveness of cognitive coping skills on pain behavior is provided by self-perception theory. Perception of pain in oneself, according to self-perception theory, involves the same process used in labelling or judging pain in others. In this sense, the individual is in the same position as the outside observer. An observer uses the pain behavior of an individual (ie. grimaces and moans) and takes into account the circumstances (ie. being hooked up to electrodes that produce shock) to infer that the person is experiencing pain. To the extent that internal pain cues are weak, individuals rely on the same external cues to infer that they are experiencing pain (Bem, 1967).

Bandler et al (1968) tested this theory on 12 male subjects who were given the opportunity to endure or escape a series of electric shocks of equal intensity. In order to escape, subjects were required to press a lever that terminated the shock. Prior to each shock, the experimenters encouraged the subjects to either escape or endure the shock although the final decision rested with the subjects. Subjects were not informed that all shocks were of equal intensity.

The results indicated that subjects' decision to escape or endure each shock matched the preference indicated by the experimenters. In support of self-perception theory, subjects rated escaped shocks as significantly more uncomfortable than those endured even though all shocks were of equal intensity. These results demonstrate how overt nonverbal behavior (escape) can be used to influence judgments about private events (pain intensity).

Fordyce et al (1981) demonstrated how overt behavior can be used to influence verbal reports in patients suffering from chronic pain. Patients exercised during a physical therapy session and rate of pain complaints following exercise was the dependent variable. Subjects were instructed to exercise until the pain they were experiencing was too great to continue. The study found a negative correlation between pain complaints and exercise. The longer a subject exercised, the less complaints he reported. These results also lend support to the self-perception theory of pain intensity.

Behavioral Coping Strategies and Pain

The use of nonverbal behaviors such as escape from shock (Bem, 1968) and exercise endurance (Fordyce, MacMahon, Rainwater, Jackbins, Questad, Murphy & De Lateur, 1981) in the investigation of pain may be better understood within a behavioral paradigm. In contrast to cognitive strategies that focus on internal pain mechanisms, behavioral strategies attempt to modify or eliminate overt pain behaviors. Several studies report the effectiveness of relaxation training, assertion training, biofeedback and functional behavior analysis for decreasing pain ratings, medication intake, and pain behavior while increasing physical activity and exercise (Fordyce, Fowler, Lehmann, DeLateur, Sand & Trieschmann, 1973; Fordyce, 1986; Fordyce, 1976; Sanders, 1983; Keefe, 1982; Nicholas, Wilson & Goyen, 1991; Taylor, Zlutnik, Corley & Flora, 1980).

Many studies have used Skinner's (1969) operant conditioning principles in the treatment and control of chronic pain (Fordyce, Fowler, Lehmann, DeLateur, Sand & Trieschmann, 1973; Gil, Keefe, Crisson & Van Dalfsen, 1987; Linton & Gotestam, 1985; Sanders, 1983; White & Sanders, 1986;). According to this view, chronic pain generally originates from a stimulus caused by injury but conditioning processes such as positive reinforcement maintain and support the pain behavior(s) even when the pain-producing stimulus is no longer present (Fordyce, 1986; Natsoulas, 1988; Rachlin, 1985). Pain behaviors can be defined as operants when positive and negative consequences follow these behaviors and increase or decrease the probability of future occurrences of the pain behavior (Fordyce, Fowler, Lehmann, DeLateur, Sand & Treismann, 1973).

Operant Conditioning and the Control of Pain

The following studies illustrate the effectiveness of operant conditioning techniques for increasing and decreasing the verbal reporting of pain. Gil et al (1987) examined the effect of positive reinforcement on pain behavior in 21 male and 30 female subjects in a pain management program. Subjects completed a social support questionnaire and a pain questionnaire. The support questionnaire was used to divide subjects into high and low in terms of social support regarding their pain condition. The pain questionnaire provided an overall pain rating for each subject. Overt pain behaviors such as grimacing and sighing were observed while subjects engaged in a number of daily activities including two-one minute walking periods and a one and two minute sitting period.

Findings indicated that there was no difference in total pain behaviors or total pain ratings between subjects high versus low in terms of social support. Pain behavior, however, varied as a function of satisfaction with social support. Subjects who reported high satisfaction with support displayed higher levels of pain behavior and reported greater overall pain ratings. The implications of this study from an operant-conditioning perspective suggest that social support acts as a positive reinforcer for pain behaviors and pain ratings.

Individuals who receive the most support in the form of attention, sympathy and understanding from others rate their satisfaction with social support as high. In addition, these individuals report the highest overall pain ratings and engage in a high number of pain behaviors. Overt pain behavior displays indicate to observers that an individual is experiencing pain. Pain behaviors are subject to learning principles in that pain behavior leads to positive consequences in the form of empathetic actions from others. In this sense, individuals learn to display pain behaviors because social reponses reinforce and maintain these behaviors rendering a high probability of future pain behaviors.

Linton and Gotestam (1985) examined the operant conditioning of pain reports in two studies using positive and negative verbal statements as reinforcers for pain responses. In the first experiment, 5 control subjects were subjected to 15 trials of pain induced with a blood-pressure cuff. Pain intensity was held constant across trials. Subjects were asked to rate the pain following each trial. Eight experimental subjects also received 15 pain trials but were verbally reinforced for increases or decreases in pain ratings. The first four trials were used as baseline and the only feedback received was a "thank you." Conditioning of responses started at trial 5.

In the "up" condition, responses higher than those indicated at baseline or the previous trial were positively reinforced with verbal statements such as "very good." Lower ratings were punished with negative statements such as "hm, this isn't good." The same procedure was used for the "down" condition except positive statements were contingent on pain responses lower than baseline and negative statements followed higher pain reports. Half of the subjects (N=4) received the up condition followed by the down condition and the procedure was reversed for the other half (N=4).

Findings indicate there was no trend in pain rating for control subjects. Although stimulus intensity was held constant, all subjects reported higher pain ratings when reinforced for increases in the up condition. Interestingly, there was an ordering effect for the down condition. When the down condition followed baseline, no decrease in ratings was observed. This finding may reflect a floor effect for baseline pain ratings. Decreases in pain ratings for all subjects occurred, however, when the down condition came after the up.

The second experiment conducted by Linton and Gotestam (1985) used similar procedures to the first study but varied the intensity of the painful stimulus. In this experiment, 5 control subjects were given neutral feedback over 15 trials of systematically decreasing levels of painful stimulation. Five experimental subjects were given an identical series of trials but were provided reinforcement for increasing pain reports while exposed to decreasing stimulation.

The findings of experiment 2 show that pain ratings for control subjects correspond to decreases in physical stimulation. As the pain stimulus decreased, pain ratings decreased. For the experimental subjects, however, increases in pain ratings coincided with decreases in physical stimulation. This study provides a clear example of the process by which operant responses can be conditioned by the principles of reinforcement. In terms of chronic pain, individuals who are positively reinforced with support or attention for emitting pain behaviors are likely to continue to display these types of behaviors at high rates. The response rate for pain behavior may stay the same or increase even when the stimulus that originally produced this behavior decreases or is no longer present.

Interestingly, the process by which pain behavior is conditioned can be initiated prior to the first display of pain. White and Sanders (1986) demonstrate the effectiveness of antecedent reinforcement on pain intensity ratings in four female chronic pain patients admitted for treatment in a university based pain center. Beginning on the day after admission, subjects were exposed over seven days to two experimental conditions in a random order.

In condition 1, subjects were asked either "How are things?" or "How are things going?" Subjects responses that included verbal complaints about pain were positively reinforced with attention, praise and sympathy. Statements indicating improvement in condition, were followed by neutral reponses. After a 5 minute conversation following the above procedure, subjects rated their current pain intensity on a 0-5 point scale. Condition 2 was identical to condition 1 except subjects were positively reinforced for verbal comments indicating improvement. Pain complaints were followed by neutral responses. The results show that pain intensity ratings were consistently lower after positively reinforcing "well talk" as opposed to "pain talk." The authors conclude that antecedent reinforcement of "well talk" may provide an initial treatment method used to promote positive changes in pain ratings.

Monetary Reinforcement and Pain

In addition to the use of positive and negative statements as reinforcers for pain behavior, a few studies have examined the effectiveness of monetary reinforcement on pain perception and tolerance. Johnson and Cabanac (1983) studied human thermoregulatory behavior during a conflict between cold discomfort and money. In this experiment, five male subjects were paid $2.50 prior to each session and 2, 5, 10, 20 or 40 cents per minute (presented in a random order) to expose themselves to increasing cold (15 to zero degrees Celsius). Subjects were instructed to stay in a cold chamber wearing only a bathing suit and shoes for as long as they could justify the discomfort in terms of money. Participants were also asked to rate their level of discomfort every 2 minutes. The first perceived discomfort was rated as 1 and subsequent levels were judged relative to one. Subjects were not told in advance how much they were being paid per minute for a session but a digital display indicated accumulated earnings during the session.

The results indicate that in 21 out of 25 sessions, subjects remained in the chamber for 66 minutes or less. Sessions were stopped if subjects endured the cold to the maximum drop in temperature. Four sessions were eliminated from the subsequent analysis because the lower limit of slightly below zero degrees was reached after two hours in the chamber. Three of the four sessions involved the same subject. Mean values for durations of cold exposure could not be calculated for the highest rates of reward (10, 20 and 40 cents per minute) because duration was imposed by the experimenters after the limit was reached in these conditions. Subjects in the 2 cent condition endured on average 19.2 minutes, while subjects in the 5 cent condition lasted for 28.8 minutes. Including the two hour limit, subjects in the 10 cent condition endured the cold on average, 59.2 minutes. The relation between monetary reward and duration of cold exposure was approximately logarithmic.

A subsequent analysis examined the goodness of fit of four models on equality of discomfort and reward. Reward was indicated by (1) rate of payment, (2) the logarithm of rate of payment, (3) total payment received or (4) rate of payment divided by the total payment. Models (2) and (4) predicted cold duration with the least error and variablility suggesting that tolerance increased when rates of reward increased exponentially.

To examine the effects of reward on assessment of discomfort, the mean discomfort ratings were plotted at each rate of reward. Discomfort rose as rate of reward increased. A positive correlation between time and discomfort suggests that subjects endured the cold discomfort for money. The researchers claim that prior assessment of subjects' need for money could have profound influences on motivation for enduring cold discomfort.

Cabanac (1986) also examined the effects of monetary reinforcement on pain magnitude and endurance using an isometric-sitting exercise. Isometric-sitting is an exercise that involves taking an unsupported position against a wall with the thighs parallel to the floor and legs lowered to a 90 degree angle. A simpler way to describe this exercise is to imagine a person sitting against a wall without a seat. This is a difficult position to maintain because lactic acid quickly builds up in the thigh muscles producing a painful stimulus.

Ten males with mean age of 20.9 ± 0.8 (SE) years agreed to participate in six experimental sessions. For each session, the subjects received 10 French francs (FF) for his participation. During the first experimental session, subjects were trained to give pain estimates every 20 seconds while maintaining the isometric position and were paid an additional 10 FF (resulting in a lump sum payment of 20 FF for this session). In the five subsequent sessions, subjects earned varying amounts (0.2, 0.5, 1.25, 3.125 and 7.81 FF) as a reward for each 20 seconds of isometric endurance. The ordering of the pay incentives was randomized for each subject.

The study found that initial increases in monetary reinforcement produced increases in endurance. However, at a certain point, endurance levelled off even though monetary reinforcement continued to increase. Thus, the utility of money decreased as a function of increasing pain. Estimates of pain increased linearly with time but did not change with rate of reinforcement.

While monetary reinforcement has increased tolerance for pain using a themoregulatory chamber (Johnson & Cabanac, 1983) and an isometric-sitting exercise (Cabanac, 1986), it has not been effective in predicting tolerance using a cold pressor test (Dolce, Doleys, Raczynski, Lossie, Poole & Smith, 1986 a). Dolce et al (1986 a) examined pain tolerance, pain intensity and self-efficacy in 64 subjects using the cold pressor test in a group by phase by subject repeated measures design. Subjects were randomly assigned to one of four experimental groups (control, quota, reinforcement and placebo) with 8 males and 8 females in each condition.

The three phases used in this experiment included a baseline trial in which subjects endured the cold-pressor test for as long as they could and then provided pain and self-efficacy ratings. Subjects were not aware of how long they lasted. Fifteen minutes after completing the baseline phase, subjects were exposed to the treatment trial. Participants were informed that a clock was present in the room and they could keep track of endurance time if they wished. All subjects were informed of their baseline endurance times.

Subjects assigned to the control condition were instructed to perform the test for as long as possible. Subjects in the quota condition were asked to double their baseline time. In the monetary reinforcement condition, subjects were asked to double their baseline time and told that they would receive five dollars (placed on the table next to them) if they succeeded. Finally, participants in the placebo condition were given a placebo tablet immediately following the baseline trial and were told it contained aspirin, a drug effective in reducing cold sensitivity. These subjects were also told to double their baseline tolerance time.

The third phase of the experiment was a follow-up trial in which subjects returned in one week and were instructed to perform the cold-pressure test for as long as possible.

The results indicate that significant improvement in pain tolerance when quotas were imposed during the treatment phase for all three conditions exposed to quotas. The highest tolerance scores during treatment were found in the quota and monetary reinforcement conditions. In addition, 94% of the quota group and 88% of the reinforcement group were able to double their baseline times compared to only 44% in the control group. Self-efficacy ratings were consistently associated with higher pain tolerance at each phase of the experiment. In addition, self-efficacy ratings increased for all groups when quotas for endurance were provided. Pain ratings and tolerance times did not correlate during any phase. Interestingly, monetary reinforcement for achieving the quota did not increase pain tolerance above the results indicated by quotas alone. The use of quotas in this study overrode any incentive provided by money. Clearly setting a quota or achievement standard is an effective technique for increasing tolerance to pain.

Quotas, Exercise Standards and Pain

The use of quota systems for the management of pain are typically aimed at increasing physical activity despite discomfort in individuals suffering from acute and chronic pain. Dolce et al (1986 b) conducted two experiments that examined the effectiveness of exercise quotas for increasing exercise levels and self-efficacy expectations in chronic pain patients. Target exercises were selected on the basis of high pain relevance to each subject from a number of common physical therapy treatment exercises. After obtaining baseline exercise levels and self-efficacy ratings, subjects were exposed to a 4 week treatment condition employing increasingly demanding exercise quotas. The results indicated that exercise quotas increased exercise tolerance.

Summary

Everyone experiences pain at some point in their lifetime. The pain encountered may be acute in nature (of relatively short duration) such as a minor headache. The pain experience may also be long-lived such as chronic back pain and result from accident or disease. Chronic pain is often life-altering in that it impairs physical activities and limits job abilities indefinitely. The prevalent occurrence of and discomfort resulting from the experience of pain has inspired an abundance of research over the last thirty years.

Substantial research has identified numerous techniques for the identification and assessment of pain experience or pain behavior. These investigations have led to the development of scales, questionnaires and other assessment tools commonly used today to diagnose acute and chronic pain. Once identified, pain behaviors have been successfully treated and/or controlled with the use of cognitive and behavioral strategies. Behavioral strategies attempt to modify or elimate overt pain behaviors while cognitive strategies focus on internal pain mechanisms.

Current research is focused on identifying the mechanisms by which cognitive coping strategies mediate pain reduction and increase pain tolerance. Common cognitive strategies involve training in coping skills (pleasant imagery, distraction, relaxation, etc.) or exposure to social models. Further investigations are needed to test the implications of self-efficacy and self-perception theories for reducing pain perception and increasing pain tolerance. These theories provide a starting point from which to develop reliable indicators to aid us in understanding the effects of cognitive and behavioral strategies designed to help individuals who suffer from acute and chronic pain.

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APPENDIX

APPLICATION FOR RESEARCH PARTICIPANT

The Centre for Experimental Sociology requires male research participants for a study of Exercise Endurance. Young males between 18 and 25 years of age will be paid for performance of isometric exercise on a variable payment basis. Participants must be healthy and not have cardiovascular problems or defects. The study requires that the participant attend a single one-hour session. If you are interested and fulfill the requirements, please complete the following information: (DO NOT OMIT INFORMATION).

Name ______________________ Social Insurance Number ______________

Address ____
Street City Postal Code

Telephone _____________ Sex _________ Age _____

Faculty ___________________ Years of University 1 2 3 4 (circle)

Do you currently have a job? Yes No (circle)

How much do you need money? (circle)

1	2	3	4	5
Not at all need	Little need	Some need	Quite a bit need	Desparately need money

Have you participated in any research at the university? Yes No (Circle)

If yes, explain ______________________________________

Do you exercise on a regular basis? Yes No (circle)

How often do you exercise? (circle)

A. Daily
B. Several times a week
C. Once a week
D. Several times a month
E. Do not Exercise
F. Other _______________

What is your major type of exercise (e.g.. running, swimming, etc.)

At the cardiovascular level, how fit are you? (circle)

A. Extremely fit
B. Quite fit
C. Fit
D. Quite unfit

E. Extremely unfit

When was the last time you had a complete physical examination by a doctor?

A. Within the last month
B. Within the last year
C. More than a year ago

Date ______________________ Signature of Applicant ____________________

TELEPHONE INTERVIEW

SUBJECTS'S NAME: ______________________ PHONE:________

HELLO, MY NAME IS DIANE SYMBALUK. I'M CALLING FROM THE CENTRE FOR EXPERIMENTAL SOCIOLOGY. I HAVE AN APPLICATION FORM HERE THAT INDICATES THAT YOU WOULD LIKE TO PARTICIPATE IN THE STUDY OF EXERCISE ENDURANCE. ARE YOU STILL INTERESTED?______

IF IT'S ALL RIGHT WITH YOU,I'D LIKE TO ASK YOU A FEW QUESTIONS. __________

HAVE YOU EVER PERFORMED AN ISOMETRIC-SITTING EXERCISE?____

(IF YES) HOW MANY TIMES HAVE YOU DONE THIS TYPE OF EXERCISE?______________________

ARE YOU OR WERE YOU INVOLVED IN A SPORT OR A TYPE OF MARTIAL ART THAT REQUIRED THIS EXERCISE AS PART OF TRAINING?_______

(IF YES) I'M SORRY BUT WE ARE LOOKING FOR PARTICIPANTS WITH LITTLE OR NO EXPERIENCE WITH THE ISOMETRIC-SITTING EXERCISE. IS IT ALL RIGHT IF WE KEEP YOUR NAME ON FILE FOR FUTURE EXPERIMENTS REQUIRING PAID VOLUNTEERS?______THANK YOU FOR YOUR TIME.

(IF NO) GREAT. WE ARE LOOKING FOR PEOPLE WITH LITTLE OR NO EXPERIENCE IN THIS TYPE OF EXERCISE. CAN I BOOK YOU FOR THE ONE-HOUR SESSION?_______.

DO YOU HAVE A PEN AND PAPER HANDY (IF NO--I'LLWAIT WHILE YOU GET ONE).
DATE:______________ TIME:_________

IT IS ABSOLUTELY NECESSARY THAT YOU SHOW UP ON TIME FOR YOUR APPOINTMENT. 2 RESEARCHERS WILL BE THERE AT THIS TIME AND FAILURE TO SHOW COSTS BOTH TIME AND MONEY. ARE YOU ABSOLUTELY POSITIVE YOU CAN SHOW UP ON TIME FOR THIS APPOINTMENT?

THE EXPERIMENT WILL TAKE PLACE AT 1-48 TORY. (SAME PLACE AS THE APPLICATION FORMS WERE SUBMITTED) DO YOU KNOW WHERE 1-48 TORY IS? (IF NO--EXPLAIN)

PLEASE WEAR LOOSE UNRESTRICTED CLOTHING OR GYM WEAR. SWEATS AND A T-SHIRT OR SWEAT SHIRT WOULD BE PERFECT.

YOU WILL BE PAID A VARIABLE AMOUNT OF MONEY DEPENDING ON THE RESEARCH CONDITIONS. YOU ARE ASSIGNED TO A CONDITION BY CHANCE BUT EVERYONE WILL RECEIVE ABOVE MINIMUM WAGE FOR THE HOUR SESSION.

REMEMBER YOUR SESSION IS ON DATE: _________ AT TIME: ______.
SEE YOU THERE. THANK YOU FOR YOUR COOPERATION. GOOD-BYE.

PARTICIPATION STATEMENT

I agree to perform an isometric-sitting exercise. Any exercise may entail a minimal medical risk. I agree to accept this risk and participate in the study. I understand that participation in this study is voluntary and that I may withdraw at any time.

I also acknowledge that any information pertaining to me will be kept strictly confidential by the researcher(s). Published data will not include any direct references to individuals participating in the study. Findings will be reported as anonymous or case data.

Signature of participant ______________________________

Thank you for your participation and cooperation.

Participant # ______

Exercise and Endurance
Pre-Study Questionnaire

As you know, this study involves isometric sitting and endurance. We want to know about your experience with this exercise and your impressions about it.

1. Have you ever performed this exercise?

Yes ____
No ____

2. If you have performed the exercise how often do you do it?

Frequently (several times a week) _____
Sometimes (several times a month) _____
Hardly ever (I've tried it a few times) _____
Other ______________________________
Not applicable ________________________

3. How long do you think you can do this exercise?

________ : ________
(minutes) (seconds)

4. How confident are you about lasting this long? (circle)

(not confident) (confident)
0 10 20 30 40 50 60 70 80 90 100

Participant # ______

For each level of endurance listed below, please indicate your ability to perform the isometric sitting exercise at that level and your degree of certainty to complete this level of performance.

Seconds of Isometric Sitting Check ( ) if you believe you are able to endure at a given level.			Degree of Certainty Circle your degree of certainty for each level you have checked.
			(uncertain) (certain)
0 - 15	____		0 10 20 30 40 50 60 70 80 90 100
16 - 30	____		0 10 20 30 40 50 60 70 80 90 100
31 - 45	____		0 10 20 30 40 50 60 70 80 90 100
46 - 60	____	(1 minute)	0 10 20 30 40 50 60 70 80 90 100
61 - 75	____		0 10 20 30 40 50 60 70 80 90 100
76 - 90	____		0 10 20 30 40 50 60 70 80 90 100
91 - 105	____		0 10 20 30 40 50 60 70 80 90 100
106 - 120	____	(2 minutes)	0 10 20 30 40 50 60 70 80 90 100
121 - 135	____		0 10 20 30 40 50 60 70 80 90 100
136 - 150	____		0 10 20 30 40 50 60 70 80 90 100
151 - 165	____		0 10 20 30 40 50 60 70 80 90 100
166 - 180	____	(3 minutes)	0 10 20 30 40 50 60 70 80 90 100
181 - 195	____		0 10 20 30 40 50 60 70 80 90 100
196 - 210	____		0 10 20 30 40 50 60 70 80 90 100
211 - 225	____		0 10 20 30 40 50 60 70 80 90 100
226 - 240	____	(4 minutes)	0 10 20 30 40 50 60 70 80 90 100
241 - 255	____		0 10 20 30 40 50 60 70 80 90 100
256 - 270	____		0 10 20 30 40 50 60 70 80 90 100
271 - 285	____		0 10 20 30 40 50 60 70 80 90 100
286 - 300	____	(5 minutes)	0 10 20 30 40 50 60 70 80 90 100
301 - 315	____		0 10 20 30 40 50 60 70 80 90 100
316 - 330	____		0 10 20 30 40 50 60 70 80 90 100
331 - 345	____		0 10 20 30 40 50 60 70 80 90 100
346 - 360	____	(6 minutes)	0 10 20 30 40 50 60 70 80 90 100
361 - 375	____		0 10 20 30 40 50 60 70 80 90 100
376 - 390	____		0 10 20 30 40 50 60 70 80 90 100
391 - 405	____		0 10 20 30 40 50 60 70 80 90 100
406 - 420	____	(7 minutes)	0 10 20 30 40 50 60 70 80 90 100
421 - 435	____		0 10 20 30 40 50 60 70 80 90 100
436 - 450	____		0 10 20 30 40 50 60 70 80 90 100
451 - 465	____		0 10 20 30 40 50 60 70 80 90 100
466 - 480	____	(8 minutes)	0 10 20 30 40 50 60 70 80 90 100
481 - 495	____		0 10 20 30 40 50 60 70 80 90 100
496 - 510	____		0 10 20 30 40 50 60 70 80 90 100
511 - 525	____		0 10 20 30 40 50 60 70 80 90 100
526 - 540	____	(9 minutes)	0 10 20 30 40 50 60 70 80 90 100
541 - 555	____		0 10 20 30 40 50 60 70 80 90 100
556 - 570	____		0 10 20 30 40 50 60 70 80 90 100
571 - 585	____		0 10 20 30 40 50 60 70 80 90 100
586 - 600	____	(10 minutes)	0 10 20 30 40 50 60 70 80 90 100

Participant #_______

Post-Study Questionnaire
Part 1

1. How long did you last in the isometric-sitting position?

   Minutes _____ Seconds _____

2. How long did it take you to feel the first instance of pain?

   Minutes _____ Seconds _____

3. What are your general impressions of the study?

4. During the experiment, did you form any specific ideas about the purpose of this study?

5. Did your ideas about the purpose of the study affect your performance? How?

Participant # ______

Part 2

6. What was the most important source of motivation for you in this study (e.g., competitiveness, self-esteem, money, etc.)?

7. How did the length of time you maintained the isometric-sitting position relate to amount of money you received?

8. How did the intensity of pain you felt relate to the amount of money you received?

9. Can you remember approximately how long the subjects in the training tape were able to hold the isometric-sitting position?

   Information not given on the tape ____ (check) or

   Your estimate ________ : ________ (minutes) (seconds)

10. Approximately, how long did it take the subjects in the training tape to feel pain?

   Information not given on the tape ____ (check) or

   Your estimate ________ : ________ (minutes) (seconds)

11. Did the training tape affect the amount of time you maintained the isometric-sitting position? If yes, how?

12. Did the training tape affect the intensity of the pain you experienced? If yes, how?

13. Can you guess the specific hypotheses that were tested in this study?

14. Any other comments?